2007

Assessment of potential agroforestry systems for Kafuta: A village in the Western Division of The Gambia

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ASSESSMENT OF POTENTIAL AGROFORESTRY SYSTEMS FOR KAFUTA: A VILLAGE IN THE WESTERN DIVISION OF THE GAMBIA

By

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Professional Paper

presented in partial fulfillment of the requirements
for the degree of

Master of Science
in Resource Conservation, International Conservation and Development

The University of Montana
Missoula, MT

Fall 2007

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Toth, Justina M. M.S. December 2007 Resource Conservation

ASSESSMENT OF POTENTIAL AGROFORESTRY SYSTEMS FOR KAFUTA: A VILLAGE IN THE WESTERN DIVISION OF THE GAMBIA

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Extensive interviews with a sample of 21 government and non-governmental workers in the natural resource field, as well as random surveys of 18 households (i.e. 18 women and 16 men) in the Western Division village of Kafuta are employed to help inform the following central research question: What agroforestry systems are the most appropriate for the village of Kafuta, given the regions unique physical, biological and socioeconomic conditions? With these two qualitative research techniques and through extensive participant observation, eight agroforestry systems are evaluated for their prevalence and general appropriateness for Kafuta. The overall themes from the analysis of each system in the Western Division are then used to assess various aspects of agroforestry implementation in the village of Kafuta. In particular, potential constraints to implementation are examined to evaluate the suitability of various agroforestry practices for the village. The results suggest that the majority of agroforestry systems are not particularly well-suited for Kafuta. There appears to be a disconnect between extension and development efforts and the interests in or acceptance of certain practices by households in Kafuta. The two key factors limiting acceptance include 1) the effect of tree planting on confounding land tenure issues and 2) the perception among villagers that fuelwood, fodder, and other potential benefits of these systems are not in short supply. Recommendations for further incorporation of certain practices that could be most suitable for and acceptable to villagers include the enhancement of homegardens and livefencing, as well as intercropping with cashews for increased income generation. The potential planting of improved fallows for future soil fertility improvement is also briefly considered.

ACKNOWLEDGMENTS

I would like to acknowledge the people who helped me through the process of writing this research paper. My committee chair, John Goodburn was actively involved in helping me to formulate the final version of this paper. He offered many great suggestions which assisted in bringing all the pieces together in a comprehensive manner. The other members of my committee, Steve Siebert and Vicki Watson, gave a great deal of support through their feedback and recommendations, both while I was overseas and on campus.

I would also like to acknowledge Peace Corps The Gambia staff for their invaluable training in social, cultural, and environmental issues within the country. I learned an enormous amount throughout my Peace Corps service which aided in the writing of this paper.

Furthermore, I would like to thank my counterpart in the village of Kafuta, Mamadi Sanneh (Gambia Department of Forestry extension worker). He assisted me in countless ways throughout the data collection process. In particular he taught me about the Gambian way of life, he tirelessly helped me contact interviewees, aided me in language translation during village surveys, and most importantly offering support and encouragement throughout the entire process. Abaraka baake!

Finally, I would like to thank my family and friends for being so patient while I was off exploring the world. Their letters and calls of encouragement were extremely valuable especially during the most difficult times helping me to complete this long journey.

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ACRONYMS AND ABBREVIATIONS

CCF	Christian Children's Fund
CRD	Central River Division
DOA	Department of Agriculture
DOF	Department of Forestry
FFHC	Freedom from Hunger Campaign
GGFP	German Forestry Project
LIVE	Livelihood Improvement through Institutional Strengthening of Food Security & Environmental Management
LRD	Lower River Division
NACO	National Consultancy on Forestry Extension Services
NARI	National Agricultural Research Institute
NBD	North Bank Division
NGO	Non-Governmental Organization
SJFF	Saint Joseph's Family Farm
URD	Upper River Division
WD	Western Division
WEC	World Evangelical Crusade for Christ

INTRODUCTION

In the developing world, rural subsistence agriculture is often seen as "the only true source of economic surplus because it is based upon the free gifts of nature" (Izac & Sanchez 2001). Rural populations are greatly dependent on the productive status of their farms for basic survival. However, throughout many regions of the world agricultural systems are experiencing rapid changes due to increasing environmental concerns, market fluctuations, and mounting population pressure (Brenes 2005).

The most pronounced agricultural change in the developing world has been the reduction of the length of traditional fallow periods spurred by population increases (Leakey 1998). This in turn has lead to widespread soil quality degradation through overuse, which has accelerated forest conversion as subsistence farmers search for new areas of productive agricultural land (Franzel & Scherr 2002; Young 1989). In Sub-Saharan Africa, commonly used agricultural systems have remained low-input/low-output even as populations have continued to steadily increase. The resulting pressures have accelerated a deteriorating land base that is now threatening the livelihood of many rural peoples (Otsuka and Place 2001). One solution to declining crop productivity and decreasing environmental conditions is agroforestry, which may be a more sustainable land management option for subsistence farmers.

In general, agroforestry is the practice of integrating trees and shrubs into farming and livestock systems. In Africa, as in many areas of the world, the idea of combining trees, animals, and crops in diverse combinations within farms is nothing new (Nair 1993). In other words, agroforestry is a new term for an old set of principles (Nair 1993). Traditional practices such as the planting of trees in homegardens and the maintenance of

trees in farm fields to enhance soil fertility are widespread throughout Africa (Miller & Nair 2006). These indigenous practices started to gain prominence in modern agricultural science within the last quarter of a century because of their potential to provide multiple benefits such as food, fuelwood, and soil conservation. Furthermore, many indigenous agroforestry practices have been modified and transformed into new techniques throughout the world (Sinclair 2004). For example, it has long been a traditional practice to plant trees among crops. More recent developments have led to the system of alleycropping, in which trees are planted in precise rows at specified distances between crops. The practice when used with nitrogen fixing trees has potential for both nitrogen fixation and the addition of organic matter to soils (Nair 1993).

As part of increased focus on agroforestry in recent decades, research and extension organizations have sought to improve the productivity of existing systems and to develop new practices in order to create solutions to the latest land-use challenges (Franzel & Scherr 2002). Within the international development community agroforestry has increasingly been seen as a land use system with great potential. Sinclair (2004) suggested that agroforestry could,

> "…improve rural livelihoods by producing more products of higher value from trees and associated crops or livestock, while conserving the resource base, in terms of ecosystem attributes like biodiversity and soil fertility, from which they are ultimately derived" (Sinclair 2004).

According to researchers, the intensification of modern agroforestry practices in developing countries around the world has the potential to help alleviate poverty by producing adequate amounts of food and natural resources in an environmentally friendly and sustainable way (Fransel & Scherr 2002; Leaky 1998; Sinclair 2004).

Most of what is known about agroforestry practices to date has come from a compilation of on-farm trial and error projects done with the cooperation of rural farmers. Such field studies have examined the positive and negative biological interactions that arise from joining agriculture and forestry practices on the same piece of land (Browder et al. 2005; Franzel & Scherr 2002; Nair 1998). Positive interactions between woody plants and annual crops include such things as increased soil nutrients and decreased wind erosion by the careful placement of trees on farms. Negative effects include increased competition for light, nutrients, and water between crops and trees, potentially reducing the yield of food crops (Franzel & Scherr 2002; Nair 1998; Thangata & Alavalapati 2003).

Likewise socioeconomic studies have been conducted to learn about farmers' motivations to continue practicing unique, native systems as well as other incentives for some to adopt new agroforestry technologies (Montambault & Alavalapati 2005; Nair 1998; Thangata & Alavalapati 2003). Various other sources provide abundant information on the degree to which agroforestry contributes to household income, food security, and overall family welfare (Franzel & Scherr 2002; Otsuka & Place 2001).

As an environmental/forestry extension worker in the Peace Corps, I became interested in agroforestry and how it was being implemented in The Gambia. Living and working among resource professionals and farmers that were aware of different forms of agriculture, interested me in investigating the current status of agroforestry in my assigned village of Kafuta, as well as throughout the Western Division of The Gambia. Much of my 27 month Peace Corps stint involved the promotion and implementation of

various agroforestry systems, which allowed me to work closely with the local people in carrying on a range of agroforestry related projects.

In The Gambia, agroforestry is being promoted by the local government, as well as non-governmental organizations (NGO's) because of its potential as a relatively cheap and promising method to help solve multiple social and environmental problems that plague the country. For example, three prominent NGO's in the country have recently teamed up to promote a new program called "Livelihood Improvement through Institutional Strengthening of Food Security and Environmental Management" (LIVE). LIVE is focused on the welfare of women and young adults through various agroforestry related components such as vegetable production, woodlot establishment, orchards, and animal management.

Most agroforestry in The Gambia is practiced through traditional methods such as tree planting around farm boundaries and within farm fields. Other agroforestry technologies promoted by development agencies have apparently been tried as well, but have been marked with little or no success. In a sense agroforestry does not seem to be living up to its theoretical potential within the Western Division, with Kafuta providing a specific example within the Division.

The intention of this project was to investigate current agroforestry practices in The Gambia to discover which systems, if any, were well suited to the particular physical, biological and socioeconomic setting of Kafuta. Qualitative survey methods were used to investigate which agroforestry systems would most likely be able to maintain or improve the livelihood of rural farmers and the environmental status of farms in the village of Kafuta. Like many other villages in The Gambia, Kafuta is faced with decreasing crop productivity, low soil fertility, and an undiversified agricultural base that is highly

dependent on the fluctuating groundnut (peanut-*Arachis hypogaea*) economy. In addition, the region is plagued with several environmental problems such as recurrent bush fires, drought, and forest conversion for agricultural production prompted by accelerating population growth. This combination of factors, which are all influenced by governmental policies, has created a situation where many Kafuta villagers are unable to meet basic subsistence needs.

A series of semi-structured interviews were conducted with two main target groups. The first target group consisted of 21 resource professionals in the natural resource field. These individuals ranged from forestry and agriculture extension agents to non-governmental (NGO) and government representatives. The specific questions posed to this group were intended to investigate which agroforestry systems were currently being promoted by organizations, as well as which had been successfully implemented in the area and were now providing benefits such as, increased food production, soil quality preservation, and improved household income generation. The second group interviewed was made up of a random sample of the local population of Kafuta (i.e. 18 households, 18 women and 16 men). The questions posed to the local villagers were aimed at exploring which systems they felt were being adopted and were providing benefits in terms of improved livelihoods for villagers or enhanced environmental conservation within the village of Kafuta.

The overall goal of the two surveys was to determine which agroforestry practices had endured past the initial promotion stage and were actively being maintained because of the benefits they provided. The surveys were intended to examine the physical, biological, and socioeconomic factors influencing agroforestry implementation in The

Gambia. The study helped clarify which agroforestry practices appeared to be the most appropriate for the Western Division of The Gambia, and in particular for the village of Kafuta.

THE GAMBIA: GENERAL BACKGROUND

The Gambia is a small country in West Africa surrounded on three sides by Senegal and on the fourth by the North Atlantic Ocean. It is situated halfway between the equator and the Tropic of Cancer at the latitude of 13° 28' north and the longitude of 16° 34' west. (Brown et al. 2002; Zimmermann 1994) (Figure 1). The Gambia is the smallest mainland African country covering a total land area of 4,361 miles (11,295 sq. km) (May 1970). At its widest point along the coast, it is only 30 miles (48 km) from north to south and is approximately 290 miles (470 km) long from east to west (Hughes & Gailey 1999, CIA 2007).

The country is almost perfectly divided down the center by The Gambia River splitting it into two banks, north and south. The river runs the entire length of the country and is navigable by large vessels up to 150 miles (240 km) upstream (May 1970). The only major river crossings supplied with public ferries are in the capitol city of Banjul near the west coast and approximately 75 miles inland between Mansakonko and Farafenni (Judd 2004).

The majority of The Gambia is engulfed by the floodplains of the Gambia River, thus making the terrain fairly flat. However, in certain areas, the landscape is scattered by low hills and small plateaus (U.S. Department of State 2007). The general landscape of the country can be classified into four main features; the floodplains, the colluvial slopes, and the lower and upper plateau (Sillah 2000). Predictably, soils are swampy and saline next to the banks of the river. On higher ground the soils are typified by light, sandy loams. Along the hillsides and bluffs, the soils are a mixed-colluvial composition (Brown et al. 2002).

The Gambia is situated in the Sub-Saharan tropical climate zone, defined by two distinct seasons, wet and dry (Madge 1995). The dry season is cooler in temperature and normally lasts around eight to nine months ranging from late October to June. The dry season is accompanied by the Harmattan Winds which brings strong, westerly airstreams accompanied by dust from the Sahara Desert (May 1970). This long dry period is relieved by the heavy, monsoonal rains of the hot and humid wet season, that typically last from mid-June to late October (CIA 2007).

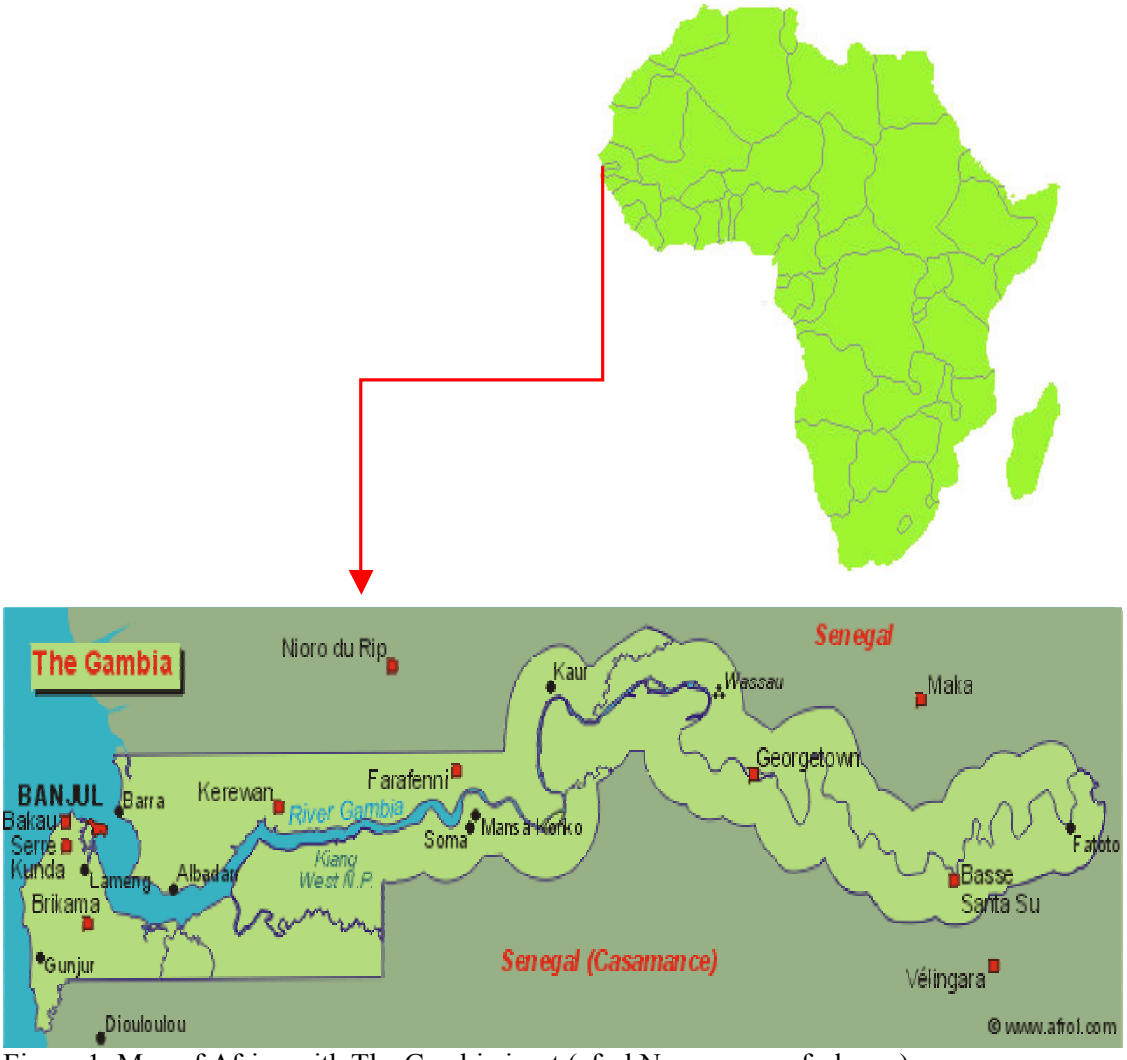


Figure 1: Map of Africa with The Gambia inset (afrol News-www.afrol.com)

The semi-arid climate of The Gambia supports Guinea Savannah and Guinea Woodland Savannah in the uplands regions of the country (Norman et al. 1981). In addition, the following plant associations can be found within the country: beach sands and coastal scrub, coastal wetland, mangroves, brackish and freshwater swamps, salty mud flats, gallery forests as well as savannah woodland, parklands, and bush fallow (Sillah 2000).

The Gambia is a former British colony that gained independence in 1965 and has since remained an independent state, even though Senegal has made numerous attempts at federation (Hughes & Gailey 1999). Today, The Gambia is composed of six administrative divisions (Figure 2), including the Upper River Division (URD), the Central River Division (CRD), the Lower River Division (LRD), the North Bank Division (NBD), the Western Division (WD), and Kombo which comprises the urban areas and the capitol city of Banjul. Each division has elected town and municipal councils. In some instances tribal chiefs retain traditional powers under customary law (U.S. Department of State 2007).

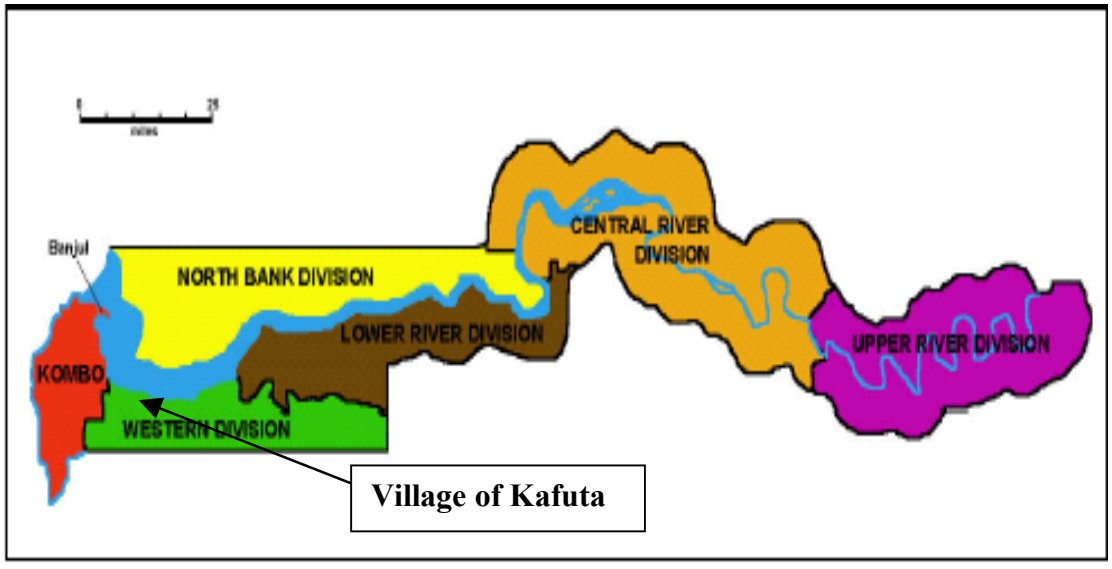


Figure 2: The Gambia's six administrative districts with village of Kafuta included (Paulete 2006)

The people of The Gambia are ethnically diverse, with 14 distinct ethnic groups or tribes that create a colorful history and cultural mosaic (Madge 1995). The five most prominent tribes are Mandinka, Fula, Wolof, Jola, and Serahuli (CIA 2007). The official language of the Gambia is English, although less than 2% of the population can speak it and government offices and schools are the only major institutions which use English on a regular basis (Brown et al 2002, Zimmermann 1994).

Instead the most commonly spoken language across The Gambia is Mandinka, from the country's largest ethnic group, The Mandinka, which comprises 42% of the population (CIA 2007). The Mandinka people were some of the first immigrants to the country, originating from the Sudan and what historically was the vast Malian empire (Zimmermann 1994). Their population is prevalent throughout the country, but most are congregated in the western half of the country (LRD, NBD, and WD). Recently, there has been a significant migration of Mandinka people to the more urban centers in the Western Division and greater Banjul area in search of work (Brown et al. 2002). But traditionally, Mandinka women have been rice cultivators while the men farm millet, sorghum, and groundnuts (Brown et al. 2002). This type of farming scheme is still common in Mandinka villages today.

The second largest ethnic group is the Fula people who comprise 18% of the population. Historically the Fula have been mostly concentrated in the eastern half of the country in the Central River Division and Upper River Division (CIA 2007). In recent years however, the Fula have also made a shift west to the urban centers in search of new employment opportunities in the tourism and mercantile sectors. The Fula tribe is originally from eastern Senegal and Guinea's Fouta Djallon plateau. They migrated to

The Gambia in the 16th century in search of additional pastoral lands (May 1970). The main occupation of the Fula people is cattle herding, although in the present day many also farm alongside the Mandinka people. With centuries of co-habitation, these two ethnic groups have created a mutually beneficial relationship in their agricultural practices. At the end of the rainy season, after the Mandinka people's final harvest, the Fula rotationally stake their cattle throughout the farming fields. This provides much needed manure for the fields and in return the cattle are free to graze residual crop stalks and field grasses (Brown et al. 2002).

The people of The Gambia are overwhelmingly impoverished and more than 63% of the Gambian population lives in rural villages (U.S. Department of State 2007). The country ranks 155 out of 177 countries in the United Nations human development index for all nations, with a per capita income of only around $330 (Foreign Common Wealth Office 2007, U.S. State Department 2002). For many families, the severity of poverty varies from year to year due to changes in family structure related to illness, marriage, and death. Household security is also dependent on the success of crops due to environmental factors such as annual rainfall patterns and insect/disease attacks (Brown et al. 2002). The most serious issue in terms of survival for families in The Gambia is that of "seasonal hunger". For several months each year, at the end of the dry season, food reserves reach very low levels. This is a time of year locally known as the "hunger season" when food reserves are at their lowest, while at the same time farming labor is the most physically demanding, requiring greater amounts of food energy (Brown et. al 2002).

Over two-thirds of the population is directly dependent on the environment for their survival, i.e. those working within the agriculture, forestry or fishing sectors (Foreign & Common Wealth Office 2007). An even larger proportion of the population (75%) is involved at least part-time in the production of crops or the rearing of livestock. Yet only one-sixth of the Gambia's total land mass is arable and capable of sustainable management for agriculture (Zimmermann 1994).

Because The Gambia has no major mineral or oil resources, the remainder of the population depends on the small-scale industrial sector and tourism for their livelihoods (Schiller 2005). The country has become a prime tourist destination for many European visitors. The sandy beaches and warm sub-tropical climate make The Gambia a nice retreat from the harsh winter months of Scandinavia. In recent years, the tourist industry has provided numerous economic opportunities, which have accelerated a large migration of people to the coastal regions (Zimmermann 1994). Young people, in particular, have moved to the urban areas in large numbers, searching for work in the tourist industry. Some are hoping to find independence and freedom from the traditional village life, while others are looking for additional incomes to help support families in the provinces.

In terms of agricultural activity, The Gambia is primarily dominated by the annual farming of crops for subsistence purposes. In fact, 75% of the labor force is involved in agricultural production which accounts for about 30% of gross domestic product (GDP) (U.S. Department of State 2007). Success in farming in The Gambia is almost entirely dependent on seasonal weather patterns, forcing the people to follow a seasonally adapted livelihood strategy (Madge 1995). Most farming occurs in the wet season when rain consistently falls every day for three to four months (mid-June to late October). The

main crops under cultivation are groundnuts (peanuts), rice, corn, millet, sorghum, and manioc (Zimmermann 1994). Many types of vegetables, fruits, roots and tubers are also grown (May 1970). Farming in The Gambia is for the most part un-mechanized. The average male farmer uses a basic hand plow, machete, and axe to clear his fields. Some farmers who are better off, employ plows powered by horses, mules, and cattle. Female farmers use only a local style hoe, called a *daba*, for field preparation and weeding (Judd 2004). Brown et al. (2002) provide a good layout of the typical farming schemes in Gambian villages based on relative distance from the river (Figure 3).

Among all agricultural crops, groundnuts are the principal basis of the country's foreign trade, making up more than 80% of total exports (May 1970; Kane 2006). Groundnut production takes up around 50% of the country's cultivated land (Hughes & Gailey 1999). They were introduced to The Gambia during the colonial era and were intended to replace the slave trade as the primary money making enterprise (Fletcher 1977). Since colonialism, groundnuts have historically been the chief crop grown by local farmers for both household and national consumption (Zimmermann 1994). More recently, their economic importance has declined over the past decade and now accounts for only 27% of the country's foreign earnings (Schiller 2005; Kane 2006). So even though groundnuts make of 80% of the country's total exports they are only bringing in a small portion, 27% of the countries entire foreign earnings. Other export crops such as cashew nuts and sesame seeds have been on the rise, although not nearly to the same extent as groundnuts.

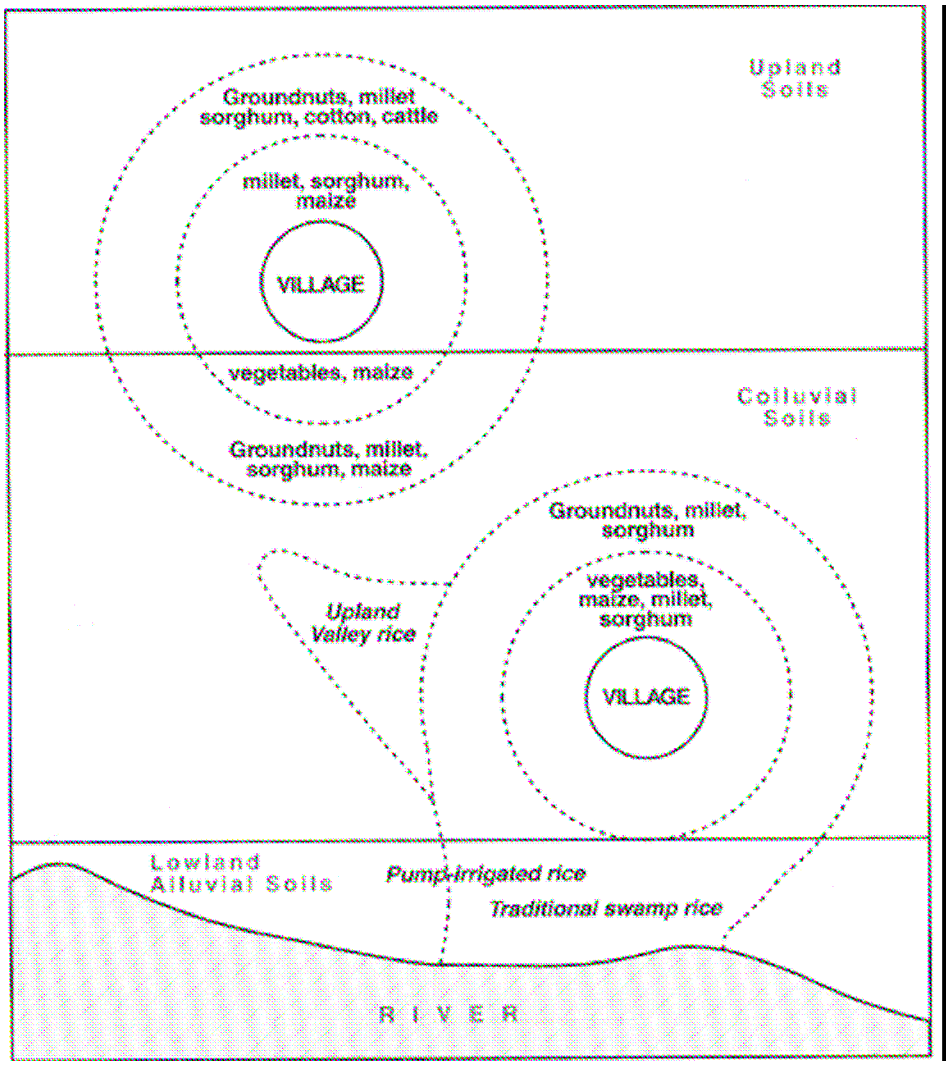


Figure 3: Farming schemes for upland and lowland villages in The Gambia (Brown et. al 2002)

Groundnuts provide a good example of the seasonality of agriculture in the region. The groundnut planting season begins with the first rains in June and harvesting commences in late October, but may not be completely finished until mid-December. After the nuts are pulled from the plant, the remaining stalks are either burned on-site or carried to animals for livestock fodder. Although these stalk disposal practices make it easier to cultivate and plant the next season, transporting the stocks off-site to be used for animal feed removes some nutrient capital from the farm (Kane 2006). Typically the

land must be periodically fallowed for several years to allow for nutrients to rebuild and replenish (May 1970). Farmers either have to rotate their crops to previous lands that have sufficiently regenerated or clear new fields out of the bush every few years (Kane 2006).

Since the expansion of groundnut production in the early 19th century, the farming of rice has declined. The Gambia used to be largely self-sufficient in rice production but is now heavily dependent on imported rice. Increasing levels of land, resources, and labor have gone into the production of the cash crop groundnuts and away from the staple crop, rice (Brown et. al 2002). In fact, imported rice is now preferred over local rice in most communities (May 1970). Although it is of lower nutritional value, people have become accustomed to the taste and easier preparation of the machine polished, imported rice (May 1970). Beginning in the 1970's, the government tried to rectify this rice production discrepancy by opening up new land in the river swamps to rice expansion and by developing trade channels for home-grown rice (May 1970). The program was effective in increasing rice production somewhat, although not to the same scale as the huge volume of rice imports.

Besides the predominance of groundnut production, unrestrained population growth is another major obstacle for the Gambia's subsistence based agricultural economy, which historically utilized large amounts of land to support relatively small numbers of people. The population of The Gambia is now approaching 1.7 million (CIA 2007). It has one of the highest population densities in all of Africa, with around 400 people per square mile and an annual population growth rate of around three percent (Ham et al. 2006; CIA 2007). Because of the country's high birth rate, the population is

expected to double in the next twenty years (NARI 2004). As The Gambia's population continues to expand, its natural resource base is also deteriorating because of increasing population pressure. Pressure to feed growing families has inhibited many farmers from properly fallowing farm fields. Consequently much of the country's farming land has been seriously degraded and is becoming less and less productive. This has become one of the most serious land use concerns in The Gambia, i.e. the reduction in soil productivity (Sillah 1998).

For the most part The Gambia is well suited to grow both groundnuts as a cash crop and rice as a staple food. The country is endowed with both sandy plateaus where groundnuts thrive and abundant marsh lands where rice is typically grown (Brown et. al 2002; May 1970). However, in recent years Gambian soils have become seriously nutrient deficient through the intensification of agricultural production for groundnut production and population growth. The soil nutrient capital and organic matter are being depleted faster than they can be replenished under current practices (Danso & Morgan 1993). Presently in The Gambia, farm soils are increasingly acidic and of fairly low overall fertility (Danso & Morgan 1993).

The consequent resulting declines in land productivity have forced resource poor farmers to clear new agricultural lands out of the few remaining forest reserves. A large majority of historical forests in The Gambia have already been converted for agricultural production, leading to dramatic country-wide changes in forest vegetation (Sillah 1999). Woodlands characterized as virgin forest are still being converted at an estimated rate of about 1.3% annually (Sillah 1999). Remaining vegetation has begun to make a shift from older, closed canopy forest to more open, secondary forest or savannah (NARI

2005; Sillah 1999) (Figure 4). Deforestation due to agricultural conversion for groundnut production, as well as domestic food production is a serious threat for the future of The Gambia because of its implications for future shortages in timber and fuelwood reserves.

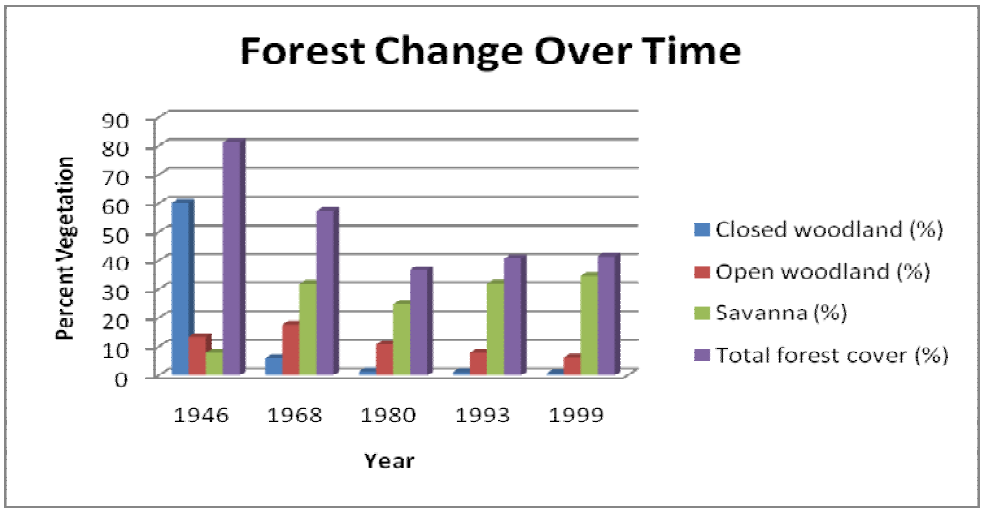


Figure 4: The Gambia's forest change over time. Adapted from (Sillah 1999)

In addition to the conversion of vegetation for agriculture, bush fires are one of the biggest threats to Gambian forests. Frequent, high intensity fires burn on average eighty percent of the country's forested land every year (Sillah 1999). This is an enormous percentage considering that the Gambia is a small country with already limited forest cover. The cause of almost all fires within the country can be attributed to humans (Bojang & Reeb 1998). One of the biggest causes of bush fires is traditional agricultural land management techniques. Farmers routinely prepare their groundnut fields by setting fire to leftover debris piles, thus making field preparation easy for subsequent planting, most likely because nutrients are reincorporated back into the soil and weeds are significantly reduced (Cairns ed. 2007; Kane 2006). Although this practice saves farmers time and energy it often leads to uncontrolled bush fires. Unattended residue

piles can quickly spread to neighboring fields and forest reserves destroying young forest vegetation. Other causes of fire include smokers carelessly tossing cigarettes into the bush, children hunting small game such as rodents and rabbits with the use of fire, individuals smoking out natural beehives in order to extract the honey, and livestock owners burning the bush to promote regeneration of palatable grasses for animals (Sillah 1999).

The high percentage of annual bushfires has also led to other environmental concerns as well. Destructive fires have been linked to changes in habitat for indigenous plant and animal species, resulting in changes to the overall species composition and bio-diversity of The Gambia (Sillah 1999). Bush fires have also reduced the harvestable biomass for fodder and much needed fuelwood (Sillah 1999).

The potential for increasing drought-like conditions related to global climate change is also a major environmental threat to rural Gambian communities. The timing and distribution of annual precipitation is an important factor to farming success in The Gambia (Brown et al. 2002). Intermittent and low precipitation throughout the rainy season is a serious threat to the livelihood of subsistence farmers who depend on adequate rainfall for sufficient crop production for survival. Irregular variability in precipitation during the height of agricultural production has been occurring all too often in The Gambia in recent years. It has become more common to see shorter rainy seasons characterized by sporadic dry spells during crucial times of crop maturity (NARI 2005). In fact, total annual precipitation in The Gambia has dropped by thirty percent in the last thirty years (CIA 2007). The drastic shortfall in precipitation has resulted in the water table falling by as much as 4.6 meters in some parts of the country (Paulete 2006).

The Gambia is in need of new ideas and possible solutions to relieve its compounding resource scarcity issues. Government initiatives, countrywide awareness campaigns, and NGO projects have had some success in slowing disastrous environmental degradation, yet the integrity of The Gambia's environment and the livelihood of the people still remain in jeopardy as the country is faced with increasing agricultural expansion, excessive dependence on one cash crop, expanding population, recurrent bush fires, and climatic change. To address some of these issues, some have advocated a land management strategy that more substantially incorporates the use of agroforestry practices.

Agroforestry is a land management system that could potentially offer some plausible solutions to resource problems within the country. Agroforestry is defined as a natural resource management system that through the integration of trees on farms with the occasional incorporation of livestock diversifies and sustains agricultural production for enhanced social, economic and environmental benefits (Franzel & Scherr 2002). Certain agroforestry practices have already been promoted and implemented on a small scale within The Gambia throughout the last twenty years. The intensification of sustainable agroforestry practices could help to alleviate many current land use problems, in addition to offsetting negative effects of future environmental dilemmas.

A broad definition of agroforestry encompasses several systems operating in The Gambia which may normally fall under other definitions, such as social or community forestry. Yet, certain land management systems employed in The Gambia can also be classified as agroforestry systems because of the community service functions they provide, which involve farmer participation of tree or animal component implementation.

For use in this study, "agroforestry" is defined as any land management system that incorporates trees or animals within a farm or community setting.

As many have pointed out, agroforestry is a relatively new science based on an old set of land use principles (Nair 1993). Small-scale farmers throughout developing countries have been practicing various forms of agroforestry for centuries, however during colonial times the key focus of third-world development was on traditional forestry in large forest plantations. It has only been within the past few decades that this approach of combining both forestry and agricultural practices has really taken hold in modern research and development planning.

In the 1970's a global awareness of third-world poverty began to take shape. Many in the development community had come to realize that the promises of the "Green Revolution" had not reached or benefited much of the developing world. In these regions, farming practices were still relatively the same as they had been for generations. Most farmers were still producing at only a subsistence level with little or no outside inputs, such as fertilizer and genetically improved seed (Nair 1993; Sinclair 1999).

The lack of progress for the third-world farmer was in itself not overly alarming to onlookers, but rather the fact that poverty seemed to be increasing in developing countries while the rest of the world experienced improved living standards. This disparity spurred further interest in agroforestry as an alternative to the Green Revolution. Beginning around the mid-1970's, global organizations such as the World Bank and the United Nations started to raise interest in integrating both agriculture and forestry into farming systems as a means of relieving poverty (Nair 1993).

In addition, scientists showed increasing interest in learning more about its potential to address numerous environmental issues, particularly deforestation and forest degradation. Traditional farming practices such as shifting cultivation were increasingly being blamed for much of the world's forest deterioration (Nair 1993). 'Shifting agriculture' involves the cutting and burning of either virgin patches of forest or previously fallowed secondary forest patches for the purpose of planting agricultural crops (Sinclair 1999). Shifting cultivators have traditionally grown crops on cleared patches of land for two to three years and then allowed the land to regenerate through a long fallow phase of at least 10 years.

For centuries this method was an efficient, sustainable way of growing food crops. However, due to increased population pressures, shifting cultivation was no longer seen as a sustainable agricultural practice in many parts of the world. For instance, in The Gambia resource poor farmers seeking ways to feed a growing population and increase groundnut production have been forced to decrease their normal fallow phase from over ten years to just three years (Madge 1995). This in turn has led to the depletion of soil nutrient stores, and consequent declines in crop yields, thus perpetuating a vicious cycle of crop production declines and clearing of new land (Lose et al. 2003).

Agroforestry practices have been promoted as having the potential to help developing nations move towards more suitable agricultural schemes. The developed world has typically perceived shifting cultivation as a destructive land management practice. Therefore, policy makers in the development community have looked towards agroforestry for a solution. The World Agroforestry Center was created in the late

1970's and has since served to encouraged the development of research and extension efforts necessary to evaluate the potential of agroforestry (WAF 2007).

In the past 30 years, agroforestry research has expanded from investigations based solely on biophysical interactions such as soil composition and crop yield, to include results from socioeconomic, anthropological, and environmental conservation studies (Montambault & Alavalapati 2005). Several decades of such research suggest that it is important to understand how agroforestry interacts with both the biophysical and societal conditions of specific regions (Montambault & Alavalapati 2005). Success with agroforestry appears to be incredibly dependent on site specific conditions, and is thus not a panacea for resource management issues throughout the entire world (Nair 1993). For example, the potential of alleycropping has often been overly promoted in climatic regions that are not well-suited for the practice because the system requires favorable site conditions to work sufficiently, i.e., adequate precipitation, relatively level ground, and soils which are non-acidic (Nair 1998).

The various agroforestry practices in use today can be classified and compartmentalized in different ways (Table 1). The three most widely used categories are agrisilvicultural, agrosilvopastoral, and silvopastoral systems (Nair 1993). Agrisilvicultural systems are those agroforestry practices that combine only two components of agroforestry--crops and trees. Some practices that fall under this category are improved fallows, alley cropping, home gardens, windbreaks, and fuelwood production (Nair 1993). Agrosilvopastoral systems merge all three components of agroforestry--trees, crops, and animals. A few practices under this system are home gardens involving animals, multipurpose woody hedgerows, aquaforestry, and apiculture

with trees (Nair 1993). The final system, silvopastoral involves only trees and animals and contains practices like fodder banks and trees on rangelands or pastures (Nair 1993).

Agroforestry Practice	Brief Description	Agroecological Adaptability
Agrisilvicultural Systems		
(1) Improved fallow	Woody species planted and left to grow during the fallow phase	In shifting cultivation areas
(2) Taungya	Combined stand of woody and agricultural species during early stages of establishment of plantations	All ecological regions (where taungya is practiced)
(3) Alleycropping (hedgerow intercropping)	Woody species in hedges; agricultural species in alleys in between hedges	Subhumid to humid areas with high human population pressure and fragile soils
(4) Multilayer tree gardens	Multispecies, multilayer dense plant associations with no organized planting arrangements	Areas with fertile soils, good availability of labor, and high human population pressure
(5) Multipurpose trees on crop lands	Trees scattered haphazardly or according to some systematic patterns on bunds, terraces, or plot/field boundaries	In all ecological regions esp. in subsistence farming; also commonly integrated with animals
(6) Plantation crop combinations	Integrated multistory (mixed, dense) mixtures of plantation crops (various arrangements)	In humid lowlands or tropical humid/subhumid highlands; usually in smallholder subsistence system
(7) Homegardens	Intimate, multistory combination of various trees and crops around homesteads	In all ecological regions esp. in areas of high population density
(8) Trees in soil conservation and reclamation	Trees on bunds, terraces, raisers, etc. with or without grass strips; trees for soil reclamation	In sloping areas, esp in highlands, reclamation of degraded, acid, alkali soils, and sand-dune stabilization
(9) Shelterbelts and windbreaks, live hedges	Trees around farmland/plots	In wind-prone areas
(10) Fuelwood production	Interplanting firewood species on or around agricultural lands	In all ecological regions
Silvopastoral Systems		
(11) Trees on rangeland or pastures	Trees scattered irregularly or arranged according to some systematic pattern	Extensive grazing areas
(12) Protein banks	Production of protein-rich tree fodder on farm/rangelands for cut-and-carry fodder production	Usually in areas with high person: land ratio
(13) Plantation crops with pastures and animals	Example: cattle under coconuts in southeast Asia and the south Pacific	In areas with less pressure on plantation crop lands
Agrosilvopastoral Systems		
(14) Homegardens involving animals	Intimate, multistory combination of various trees and crops, and animals around homesteads	In all ecological regions with high density of human population
(15) Multipurpose woody hedgerows	Woody hedges for browse, mulch, green manure, soil conservation, etc.	Humid to subhumid areas with hilly and sloping terrain
(16) Apiculture with trees	Trees for honey production	Depending on the feasibility of apiculture
(17) Multipurpose woodlots	For various purposes (wood, fodder, soil protection, soil reclamation, etc.	Various

Table 1: Major agroforestry practices and their characteristics. Adapted from (Nair 1993).

METHODS

The implementation of agroforestry systems throughout the world has been somewhat haphazard. Systems tailored to specific regions of the world have been recommended for other countries without consideration for a country's unique features. Specific biophysical, social, and economic factors of a region need to be considered before appropriate agroforestry systems can be recommended as sustainable land management options for the country in question. Without this element of specificity agroforestry systems are likely to fail in improving lives and may even be harmful in the long run.

In order to investigate which agroforestry systems might be the most appropriate for the Western Division village of Kafuta, several qualitative research techniques were applied. The methodologies used included semi-structured interviews, village based surveys, and participant observation techniques.

Government/NGO Interviews

Individual interviews were conducted with a group of government employees and NGO workers consisting of twenty-two participants, nineteen males and two females. Organizations were selected from a broad list of groups perceived to be carrying out development work in the Western Division. Individual participants were selected based on whether they had previously or were currently working within the region.

Survey participants were initially contacted either by phone or in person to ask if they would be willing to take part in an interview. Semi-structured interviews were conducted at the participant worksites, typically lasting approximately 90 minutes. All government/NGO interviews were recorded using a handheld recording device in order to ensure accurate recording of interviews. The research objectives, as well as the use of the recording

device were explained to the participants to reduce any suspicions and promote full and accurate responses.

The semi-structured nature of the interviews allowed for a thorough review of agroforestry practices within the Western Division and The Gambia as a whole. Respondents were allowed to expand upon the initial questions and in some cases were probed for additional information. Despite the primary focus being on the Western Division of the country, in some cases survey respondents also discussed what they had seen elsewhere in the country, outside the Western Division. Following the completion of the interviews all answers were meticulously transcribed for subsequent data analysis.

The following list of agroforestry practices were the focus of the interviews with the government/NGO participants:

- Alleycropping
- Intercropping with Trees
- Homegardens
- Fodder Banks
- Windbreaks
- Firebreaks
- Woodlots
- Livefences

The interviewees were asked to identify any of the above listed systems their organizations were currently promoting or had promoted in the past. Participants were asked to name those systems on the list provided they felt were the most prevalent, and to specify which were working well in the Western Division, based on either their personal observations or involvement with the systems through their jobs (Appendix A). They were then asked to elaborate on their selections in further detail. Each interview was then transcribed and entered into the qualitative computer software program NVivo, which

was used to code and compartmentalize participant responses in a comprehensive manner.

Village of Kafuta Surveys

Surveys of local villagers were conducted in Kafuta, where I was stationed for the last 14 months of my Peace Corps service. Kafuta is located about 30 km inland from the only major urban center of the country, Banjul, and is situated in the western most part of The Gambia's Western Division. Kafuta's population is estimated to be around 3,000 people and is comprised of nine wards or "kabilos" (Figure 5).

Two households within each of the nine wards or "kabilos" were randomly selected for interviews to provide a representative sample of the village population. If possible, both the male and female heads of a household in each compound were separately interviewed. A couple of households only had a female present at the time of the interview due to the male being deceased or away working outside of the village. In total thirty-four individuals were interviewed from 18 different households, i.e. 18 women and 16 men.

Semi-structured interviews with villagers utilized a different set of survey questions to obtain information about the local people's knowledge regarding various agroforestry practices and the perceived level of the use of each practice in the region. More specifically, the questions posed in the village surveys were intended to explore which agroforestry systems, if any, had been promoted in the area, and to identify those that were being actively maintained in the villager's farms. The village interview technique more closely resembled that of a broad based survey instead of the in-depth, personal interviews used with the government worker/NGO group. The questions asked were less open-ended, only allowing for short, specific responses. This type of survey technique was chosen for

ease in collecting data from a large number of participants who may or not have had knowledge about agroforestry practices (Newman 2000).

However, this type of specific questioning proved to be somewhat of a limitation to investigating which agroforestry systems were occurring in the village of Kafuta. The questions did not always directly relate to the agroforestry systems under review, rather they were used to allude to the use of certain agroforestry practices within the village (Appendix B). For example, questions like, "Do you have trees in your farm or garden?" or "If you own animals, what do you feed them?" were designed to indirectly gain knowledge about agroforestry practices in Kafuta. Therefore, the answers received from villagers were sometimes vague and unrelated to agroforestry practices, making data analysis challenging.

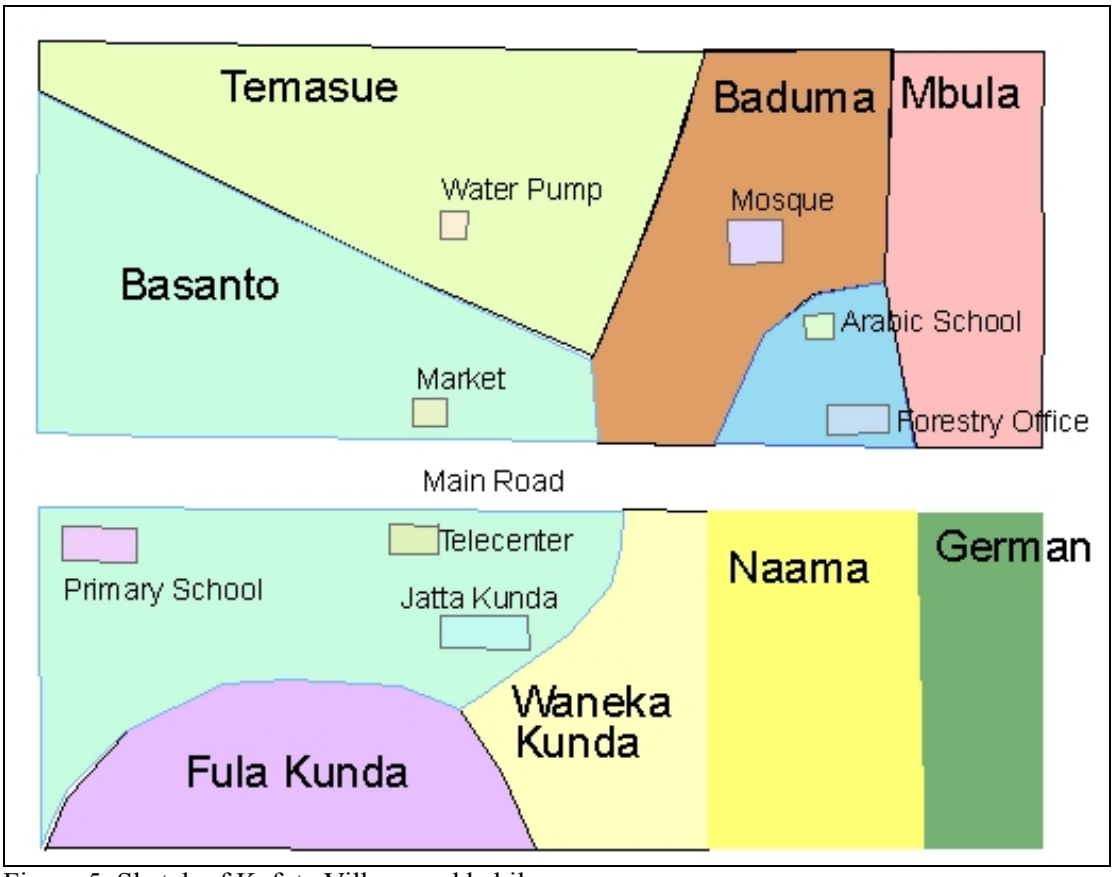


Figure 5: Sketch of Kafuta Village and kabilos

The interviews were conducted in Mandinka, the predominate tribal language of the region. An English/Mandinka speaking extension worker helped in facilitating the surveys to aid in the accurate translation of participant responses. The majority of village interviews required around 30 to 45 minutes to complete. A recording device was not used in the village surveys in order to avoid raising suspicions among villagers who were familiar with surveys but not with recording devices. Responses were recorded in abbreviated notes during the interview sessions and rewritten in more detail immediately after completion of each individual survey. Individual interviews were then entered into NVivo for further analysis.

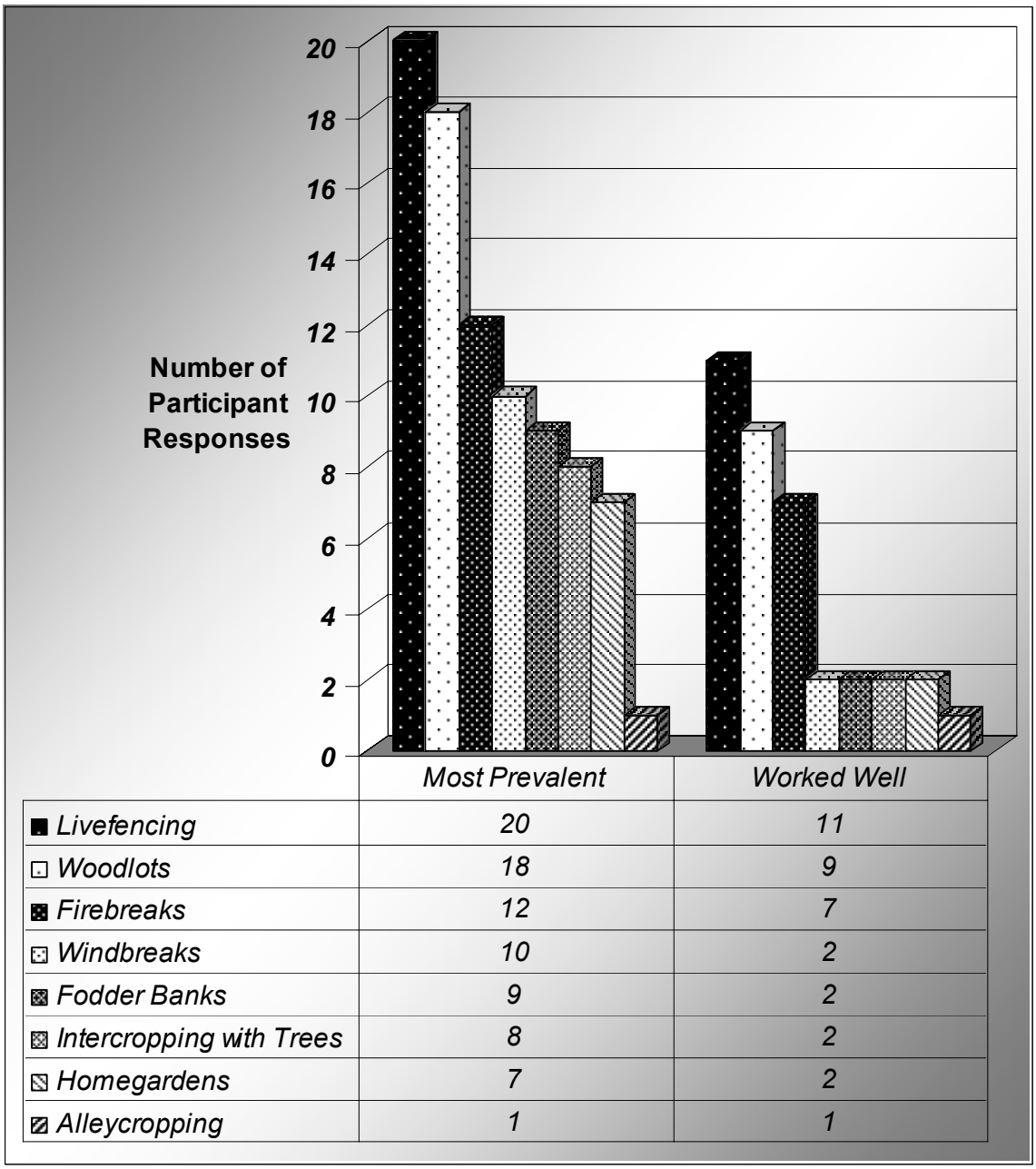
To complement the interview process, I also used participant observation techniques in an attempt to gain further insight into the perceptions of agroforestry practices in the village of Kafuta. This technique is otherwise known as an interpretive approach, where a researcher attempts to study the "socially meaningful action" of people through direct observation (Neuman 2000). As a Peace Corps volunteer working within the country for twenty-seven months, I observed first hand the various agroforestry practices taking place within the country. The last fourteen months of observation were spent exclusively in the Western Division village of Kafuta. During this time I observed first hand the various agroforestry practices implemented within the region by working with farmers in their fields. I also worked with government employees and local NGO's to carry out agroforestry trials, field preparation for agroforestry projects, and extension work for agroforestry promotion. In addition, a bike trek around the entire country was carried out to increase the understanding of how agroforestry was being applied throughout other regions of the country.

SURVEY RESULTS

Government/NGO Interview Results

Compilation of the 21 separate interviews of the government/NGO organizations revealed that all organizations had been working on some type of agroforestry projects presently or in the past, however the majority only had familiarity with a few of the selected systems. Of the eight practices listed in the survey, workers believed the most prevalent in the Western Division were livefencing (20 out of 21) and woodlots (18 out of 21) (Table 2). Firebreaks, fodder banks, homegardens, intercropping w/trees, and windbreaks were also regularly mentioned as systems being practiced, though only half as often as livefencing and woodlots. Only one participant felt alleycropping was being practiced on a widespread basis throughout the country.

In answer to which systems they thought worked well in the Western Division, the majority of respondents again cited livefencing and woodlots. Eleven of 21 indicated livefencing, while 9 indicated woodlots. The next practice most often considered successful was firebreaks, cited by 1/3 of the respondents. The remaining systems were cited by less than three respondents suggesting they were not being successfully implemented on a wide scale throughout the country (Table 3).



	Most Prevalent	Worked Well
Livefencing	20	11
Woodlots	18	9
Firebreaks	12	7
Windbreaks	10	2
Fodder Banks	9	2
Intercropping with Trees	8	2
Homegardens	7	2
Alleycropping	1	1

Table 2: Government/NGO responses

Governmental Organization Interviews	Promoted Practices	Practices which Worked Well	Major Constraints
1) DOA-Agricultural Intervention-schools	I, L, WB, W	L, W	Social, Financial
2) DOA-Extension Worker; Nutrition Department	H, L, W	H, L	Social
3) DOF-Program Director	F, FB, I, L, WB, W	I, WB	Social
4) DOF-Public Relations Officer & Extension Worker	I, W, L	F	Social, Financial, Environmental
5) DOF-Extension Worker	L, WB, W	F	Social, Financial
6) NARI Program Director	F, L	L	Social, Financial
7)Gambia College-Agroforestry Instructor	A, FB, L, WB, W	A	Social, Financial
Non-Governmental(NGO) Interviews			
8) Methodist Mission-Program Director	F, L, WB, W	L, WB, W	Social, Financial, Environmental
9) Christian Children's Fund (CCF)-Extension Worker	H, L, WB, W	L	Social
10) GGFP-German Forester Counterpart	F, I, W	F	Social, Financial
11) National Consultancy on Forestry Extension Service (NACO)-Management Staff Member	F, FB, L, W	L	Social, Financial
12) Freedom from Hunger Campaign (FFHC)-Extension Worker	F, FB, H, I, L, W	F, H, L, W	Social, Financial
13) World Evangelical Crusade for Christ (WEC)-Extension Worker	FB, I, L	L	Social, Financial, Environmental
14) U.S. Peace Corps-Associate Director	F, FB, I, L, WB, W	FB, I, L, W	Social, Financial
15) U.S. Peace Corps-Agroforestry Trainer	L, WB, W	L, W	Social
16) U.S. Peace Corps & NARI-Extension Worker	FB,I , L	None	Social, Financial, Environmental
17) Concern Universal-Program Director	F, L, W	F, W	Social, Financial, Environmental
18) St. Joseph's Family Farm (SJFF)-Field Site Program Director	F, H, L, W	FB, L, W	Social, Environmental
19) SJFF-Extension Worker (Bessi)	F, FB, H, L, WB, W	F, L, W	Social, Financial, Environmental
20) SJFF-Extension Worker (Bessi)	F, FB, H, L, WB, W	F, W	Environmental
21) SJFF-Volunteer (Bwiam)	F, H, L, W	None	Social, Environmental
Key: A=Alleycropping, F=Firebreaks, FB=Fodder Banks, H=Homegardens, I=Intercropping with Trees, L=Livefencing, WB=Windbreaks, W=Woodlots			

Table 3: Compilation of Government/NGO Responses

Over half of the government/NGO groups considered livefencing to be an agroforestry practice which was working well within the Western Division and twenty out of twenty-one participants believe livefencing was actively being implemented at various locations in the Western Division. Livefencing is an agroforestry practice where trees and shrubs are used to create a barrier which provides protection to people, their dwellings, crops, animals, and other property (Rocheleau et. al 1988). In The Gambia livefences are constructed using several different arrangements. Tree species can either act as fence posts where other materials are used to fill in the gaps between the posts or as a fence entirely where a variety of tree/shrub species are planted close together to create an impenetrable barrier (Figure 6).

Based on the interview responses, there appeared to be two main reasons why livefencing was perceived to be prevalent and successfully implemented. First, the majority of participants felt livefencing had received a great deal of implementation success because of the multiple benefits they offered such as food, fodder, and forest preservation. Secondly, many mentioned that livefences were important in creating a means to improve land tenure security. For regions like the Western Division, which are experiencing many land use changes due to increasing population densities and pressures from expanding urbanization, livefences clarify ownership and tenure issues.

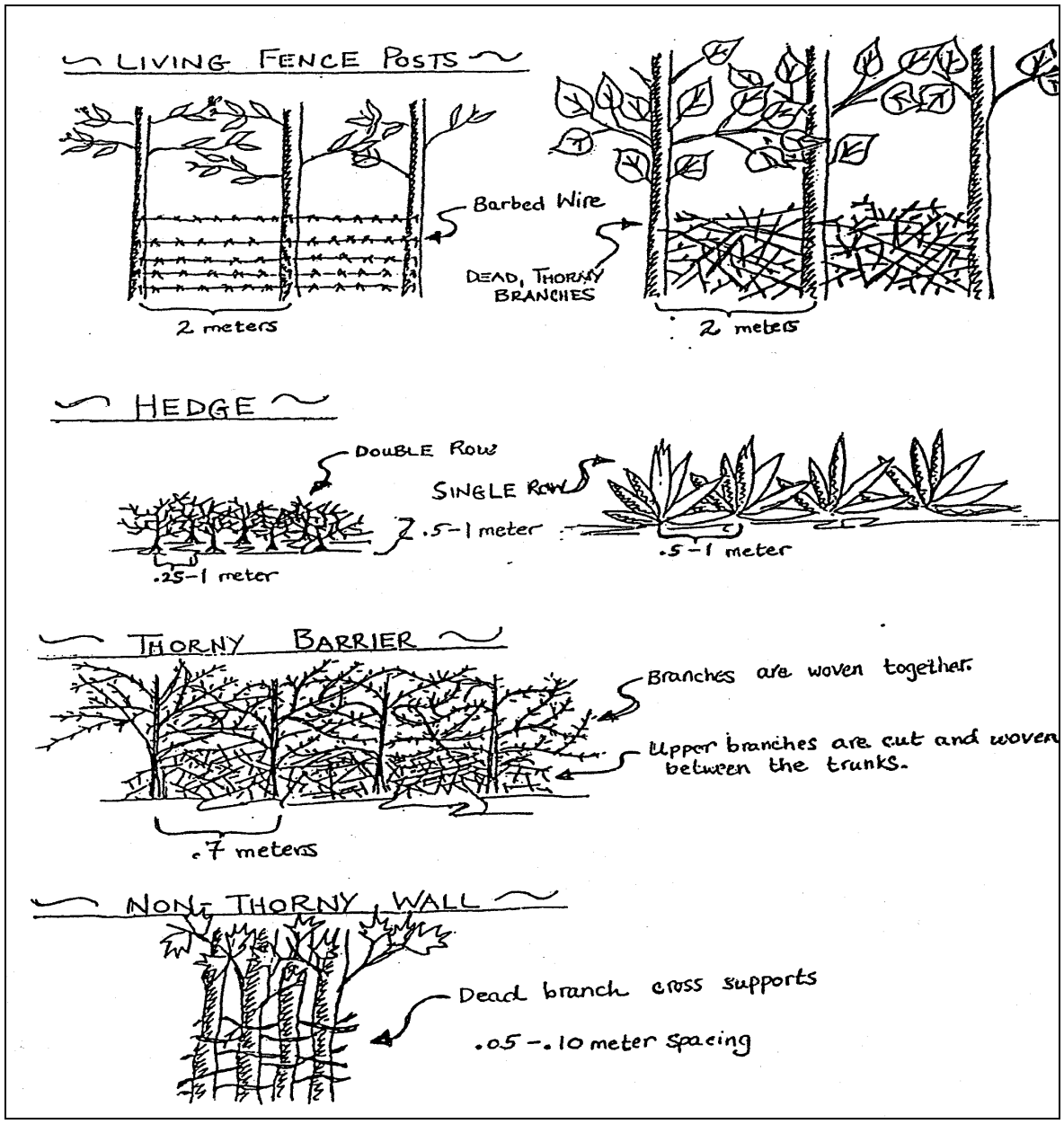


Figure 6: Various forms of livefencing (Brouwer 2006)

In addition, many interview participants spoke of the diverse products and services derived from livefences in the Western Division, including fuelwood and fodder, the relatively small cost of livefence establishment, and forest preservation. Socioeconomic research in the field of agroforestry has found that agroforestry systems with high adoption rates are usually those that offer multiple benefits to the people involved (Belsky 1993; Merem 2005; Rasul & Thapa 2006). Several of the organizations interviewed claimed they were encouraging Western Division communities to plant livefences not only for their ability to protect property but also for the multiple resource benefits they can provide. The program coordinator of an agroforestry training center in the Western Division explained how the center utilized their livefence, "We have the barbed wire here but it's not cheap. Livefencing works much better and it can also be used for other materials, like animal fodder. Kill two birds with one stone. Fence your garden and feed your animals."

The Department of Agriculture was also recommending livefences in the Western Division because of the multiple benefits involved; however they were promoting the growing of trees instead of shrubs to make up the posts of a fence instead of the entire fence. The extension agent in charge of monitoring agricultural production in the schools said the Department of Agriculture was encouraging schools who already had fruit tree orchards to plant some trees in designated spacing patterns around the orchard boundaries to serve as livefencing. He described how these fences could be very beneficial once developed since many school orchards are unfenced and have problems with theft and/or animal damage. Although the primary objective of orchard management is to generate

money through the sale of fruit and nuts, trees planted around the boundary would be able to protect the rest of the trees in the orchard.

Another extension worker reported of a similar livefence made from cashews around a mission house in the Western Division. This fence was still developing but the farm managers were quite happy with the early results. The cashew trees forming the fence had been growing for about three years and were being protected from stray animals during these first years of establishment with light wire. The community had already benefited from the cashew nuts and fruit, while the farm had gained protection of its crops. This extension worker also felt the farm had set a good example for the potential of livefencing in The Gambia.

In addition, participants shared that their organizations were promoting livefencing to rural communities because they require little financial investment on the part of the farmer. Research has shown that people are more interested in practices such as livefencing which work to relieve financial burdens by enhancing incomes or by liberating them from certain inherent costs (Laakso & Tyynela 2006; Russell & Franzel 2004). One interview participant explained that livefences are considerably less expensive to establish then fences made from barbed wire which can cost around 600 U.S. Dollars to enclose just one hectare of land.

Environmental or forest preservation was also cited as a benefit of livefencing. Livefences have been shown to reduce the amount of forest trees needed to build a reliable fence (Brouwer 2006; Laakso & Tyynela 2006; Rocheleau et. al 1988). Government offices and NGO's concerned with forest conversion have encouraged

livefencing implementation because of livefences professed potential to reduce deforestation within The Gambia.

One of the biggest additional benefits of livefencing mentioned by interview participants was the ability of livefences to delineate farm property for rural neighbors in the Western Division. Many government/NGO participants claimed that the erosion of traditional land tenure systems and increased urbanization have lead local people in the Western Division to take up some form of livefencing. Government/NGO workers had observed numerous Western Division villagers using livefencing for land demarcation. The majority were planting useful trees such as cashews to be used as fence posts for lining farm boundaries.

The majority of interview participants viewed livefencing as an appropriate agroforestry option that offers many benefits to the people of The Gambia, which is likely why the system appeared to be widespread throughout the Western Division. The manager of a private environmental consulting firm summed up the multiple benefits of livefencing as follows.

> I would say the livefencing worked very well because you know it's very expensive to purchase these barbed wires. And the sustainability of livefencing succeeds very well with communities, especially if you use some trees like lime. Then [the people] can be harvesting some of these fruits from time to time. Also for border line plantings….planting along farmland borders also works very well because this actually gives them security in the future. They normally have conflicts about this but with permanent boundaries planted with trees this can reduce future tensions with land tenure.

Even with a large degree of livefencing implementation occurring in the Western Division many in the government/NGO group still pointed out several reasons for non-adoption or unsuccessful livefencing attempts. First, the implementation and

maintenance of livefencing is often perceived by households to be too labor intensive. A volunteer at SJFF observed this element of livefencing implementation while working with villagers in Bwiam (a village about 30km east of Kafuta), he stated, "You have to come up with answers that require just a simple effort and that's why your livefencing doesn't work because you introduce the stuff and even if you give [different tree species] to them, they have to trim it after and they don't want more work." Secondly, a proper livefence takes several years to establish and local people are often not willing to wait that long to see results. Thirdly, livefencing requires some skill or knowledge about proper implementation techniques. Participants indicated that a person needs to know which species are the best to plant, as well as how they should be planted and maintained. Many villagers in The Gambia do not have this knowledge and even trained extension workers are unsure of the proper implementation techniques. One extension worker with FFHC explained that she has given training on livefencing practices but had only been taught the basics of the system herself. She was successful in helping a community start a livefence, but she did not know how to maintain the fence after the initial establishment phase.

After livefencing, woodlots were the second most often cited practice. Over 85% of the government/NGO participants believed woodlots were prevalent within the Western Division and 43% thought woodlots were working well. Almost sixty percent of the individuals interviewed said woodlot promotion and establishment were part of their project guidelines and objectives. It appeared that government and NGO workers had been trying to expand woodlot establishment throughout the country for many years.

Some woodlots had been successful and others had not due to the various limitations mentioned below.

In general, a woodlot is an arrangement of trees planted close together on a designated plot of land in order to establish an easily accessible supply of either fuelwood or timber in close proximity to the home (Rocheleau et. al 1988). Woodlots can be incorporated with the other agroforestry components of crops and/or livestock. In some instances livestock graze under woodlot species or are fed branches from mature trees (Nair 1993). Many tree species have been suggested for woodlot production in The Gambia, yet the species most widely accepted are those that grow quickly and produce a high volume of fuelwood in a short amount of time (Rocheleau et. al 1988). In The Gambia these primarily include eucalyptus (Eucalyptus cinerea) and gmelina (Gmelina arborea) which are both exotics, although other native species such as ironwood (Combretum imberbe) is sometimes used.

Several of the interviewees said their organizations had started promoting community or individual woodlots as a feasible solution to possible fuelwood shortages. At present wood resources in The Gambia are deteriorating at a steady rate. National forest inventories reveal that only a small percentage of closed forests (1.1%) remain (NARI 2005). Most Gambians use fuelwood as their primary energy source for cooking, heating, and lighting needs. Findings from a recent fuelwood survey conducted by the National Agricultural Research Institute revealed that a majority of rural, urban and semi-urban communities collected fuelwood straight from the bush instead of from other more renewable sources like woodlots (NARI 2005). Interview participants spoke of their concern for the future of The Gambia's fuelwood supplies since fuelwood was getting

expensive and everyone, even people in the urban centers were dependent on fuelwood for basic survival.

Some participants felt that their organization's success with woodlot establishment in the Western Division was related to the financial returns gained from viable woodlots. One extension worker with SJFF described how some people in the Western Division were increasingly interested in woodlot development because of income generation and the land tenure security that woodlots can provide. With an increasing amount of young people migrating to the urban centers woodlots have become a way to secure land tenure rights in the Western Division. One respondent explained the strategy as follows:

> Eventually due to this rural/urban [migration] many of the young boys have vacated their villages and their parents who are there [in the villages] are old. So the only thing to sustain their land ownership is to take their old farms, their father's farms, and convert them to woodlots.

However, even as many government and NGO organizations have been successful with woodlot promotion in the Western Division, there are still several constraints to woodlot establishment. According to NARI's fuelwood survey, a majority of Gambians are not aware of a possible impending fuelwood crisis (NARI 2005). Some of the government/NGO interview participants expressed the same view. Participants felt there was a general lack of concern over fuelwood supplies, particularly in the Western Division because large tracts of forest remained intact. Some interviewees suggested that woodlots were particularly well-suited for the North Bank Division, where the signs of desertification have been the greatest.

Another constraint to woodlot establishment addressed by respondents was the amount of time if takes for a good woodlot to be established. Research has suggested that the inherent risks associated with trying new technologies may discourage resource

poor farmers from participating in new projects if they do not see a direct and immediate benefit to participation (Izac & Sanchez 2001; Mercer & Snook 2004; Thangata & Alavalapati 2003). For example, survey participants stated that many communities were not willing to shift a portion of their time and energy away from farming in order to establish a woodlot, if the returns to labor would not be realized until several years down the road or if the woodlot was perceived to eventually be a failure.

Finally, several of the interview participants described how land tenure was one of the biggest constraints to woodlot establishment. They mentioned that in order for more woodlots to be successful in the country they would have to be individually owned because of the problems that arise from communal ownership. Securing land for community woodlot establishment has in the past proven to be difficult because individual families are seldom willing to give away their farm land for the development of a community woodlot. Furthermore, some interviewees pointed out that villagers were often not willing to invest their personal time and money into a community woodlot where they were unsure of the benefits they would receive, or how the resource would be shared with other community members.

Several of these constraints contributed to the failures of a large scale woodlot project undertaken in The Gambia in the early 1980's. This project was funded by USAID and was designed to "promote sound environmental management through the use of commercial incentives" by the development of community woodlots (Schroeder 1999). There were several reasons for the project's eventual failure. First, the selection of exotic tree species was later viewed as inappropriate because Gambians could still easily collect preferred native species from the forest. Secondly, people were not motivated to

establish woodlots because of the time factor in woodlot establishment mentioned above. Finally, the project ultimately failed because the communities were unable to distinguish user rights to benefits coming out of the project. For instance, if one person was the sole owner of the property where the woodlot was placed, then villagers were unsure of rights to the resource, therefore they were often disinterested in contributing labor to the establishment and upkeep of the woodlot (Schroeder 1999).

After livefencing and woodlots, firebreaks were the next most common practice mentioned. One-third of the government/NGO participants interviewed claimed firebreaks were a system which was working well in the Western Division and twelve of the participants thought firebreaks were a prevalent system throughout the region. Customarily, the term firebreak is used to describe a strip of land cleared of all burnable vegetation and in some instances intentionally burned to create a barrier to an oncoming fire (Mansourian et. al 2005). Yet, in agroforestry firebreaks do not involve the total suppression of vegetation. Rather they are typically designed as low tree intensity forest structures that make it easier to control grass growth under the canopy (Mansourian et.al 2005).

An agroforestry firebreak normally involves the planting of two or three strips of trees to slow or reduce the intensity of an oncoming fire (Brouwer 2006). Usually the planted tree species are somewhat fire resistant but their main function is to inhibit or greatly stunt the development of understory vegetation such as brushy shrubs and tall grasses which quickly spread fire. Firebreaks are planted along farm boundaries and forest reserves where fire is frequently a major threat to crop or forest resources.

The majority of respondents were aware of firebreaks through the country's community forestry initiative. The Gambian-German Forestry Project (GGFP) implemented firebreaks in the early nineties to help communities protect their forests from fire. These community forest firebreaks were composed of three rows of gmelina (Gmelina arborea) an exotic species and two rows of cashew (Anacardium occidentale).

In fact, the majority of Gambian firebreaks present in the country had been established as a result of this project. However other organizations had started to encourage firebreak implementation since the establishment of the first GGFP community forest firebreaks. The director of the Methodist Mission shared how his organization had started to encourage firebreaks around farms and villages in the Western Division because recent fires had burned down villages and not just forest reserves.

Some participants explained that their organizations were promoting woodlots in the Western Division because of other tangible benefits the firebreaks could provide. They shared how firebreaks were providing communities with a readily accessible supply of fuelwood, timber, food and sometimes additional income. Women and children in some Western Division communities had been observed collecting and selling the nuts from the cashew trees in their community forest firebreaks. Still others were selling excess timber and firewood which was accumulated during community forest firebreak cleanings. However, other interview participants mentioned how labor requirements were a constraint to firebreak upkeep. Villagers were often not motivated to put forth the additional labor required in firebreak maintenance such as weeding around the base of the trees and pruning backs the limbs.

Windbreaks were being promoted to a fair degree in the Western Division based on interview responses. Ten of the government/NGO participants said windbreaks were being promoted in the Western Division. But while nearly 50% of respondents (10 of 21) reported their promotion in the Western Division only two of the respondents felt that windbreaks were working well within the Division. Windbreaks are strips of trees and/or shrubs planted to protect farmland from wind and in some instances blowing sand (Rocheleau et. al 1988). Windbreaks are planted for various reasons depending on the site and the land management objectives. Some of the key reasons to plant a windbreak include the reduction of soil erosion, the improvement of microclimates for growing crops, and the sheltering of people and livestock from harsh environmental conditions (Rocheleau et. al 1988). Where wind is a major cause of soil erosion and moisture loss in dry areas such as West Africa, the main objective of a windbreak is to increase or at least maintain crop productivity (Rocheleau et. al 1988).

Several interview participants stated their organizations were actively promoting such windbreaks in the Western Division. One participant noted how Western Division communities were starting to realize the benefits of placing windbreaks in their backyards or around their home compounds to mitigate destructive forces of powerful winds and rain during the wet season. Still other participants observed windbreaks working in the Western Division as a result of the implementation of other agroforestry systems, such as livefences and firebreaks. For example, in promoting livefencing around school compounds and gardens the Department of Agriculture was trying to encourage windbreaks but mainly as a secondary objective to the planting of cashews around school gardens for income generation.

Some of the interviewees felt there was not much need for windbreaks in the Western Division. They believed the real need for windbreak implementation was in the North Bank Division which had experienced a great deal of deforestation in recent years. Respondents described the North Bank as being almost completely devoid of trees which resulted in large amounts of soil and dust being blown around villages. The Western Division on the other hand was perceived to have an abundant supply of trees which reduced the need for windbreaks.

When speaking on fodder banks, nine government/NGO participants thought fodder banks were being actively endorsed in The Gambia and two believed they were amongst the best working agroforestry systems in the Western Division. A fodder bank sometimes referred to as a protein bank is a small plot of land where a high density of nutritious shrubs or trees are grown to provide a secondary food source for livestock during periods of low fodder availability (Rocheleau et. al 1988). Fodder species are grown in protected environments and are later lopped and carried to animals that are usually contained within a stall (Nair 1993). Fodder banks are used in areas where land is scarce and the number of fodder trees maintained in fields is small (Rocheleau et. al 1988).

According to most survey participants, the majority of fodder bank production was on a very small scale with much of the implementation taking place at only a few research or training centers. For example, the program director of the National Agricultural Research Institute (NARI) said his organization was actively involved in fodder bank research, and described a system of fodder production using baobob (*Adansonia digitata*), an ancient African tree which is locally valued for its edible leaves

and fruit, malleable bark used for rope making, and religious significance (Nair 1993). NARI was encouraging the management of baobob seedlings to be used for intensive fodder production. In addition, an agricultural training farm in the Western Division had been teaching students to establish fodder banks within small woodlots.

One of the primary reasons fodder banks are appropriate, as some of the government/NGO interviewees stressed, is because of the country's long dry season where most fodderable shrubs and grasses dieback from lack of water. Several respondents explained how livestock browse from left over field debris and palatable forest grasses is usually exhausted within four to five months. Since the dry season typically lasts for several more months, livestock are vulnerable to malnutrition and starvation for a good portion of the dry season. By the start of the first rains livestock are often severely undernourished and it is not uncommon for weak animals to die from either malnutrition or being picked off by hyenas.

The constraints to greater use of fodder banks were identified as being high labor intensity involved in manually cutting and transporting tree branches to animals. Several others felt fodder banks were not workable anywhere within the country due to traditional free-range grazing practices based on communal tenure rights. Respondents felt livestock owners were not motivated to nurse seedlings for fodder bank production because animals were still allowed to graze freely. Even though some animals may have been suffering from lack of dry season feed, farmers were not willing to increase their labor requirements if every other livestock owner was still benefiting from shared grazing lands.

The next most prevalent agroforestry practice in the Western Division was intercropping with trees. Out of the 21 government/NGO participants eight thought intercropping with trees was a prevalent agroforestry system, however only two felt the system was working well within the Western Division. From the government/NGO perspective more intercropping with trees appeared to be developing in the country, yet at a slow rate. Intercropping with trees is an agroforestry system also known as agroforestry parklands, where crops are planted under trees in farmers' fields (Boffa 1999; Nair 1993).

In subsistence farming trees are often viewed as a hindrance to crop production since they compete with crops for space, nutrients, and sunlight (Lose et al. 2003). Therefore, in many intercropping systems, trees are more or less a secondary component as crop production remains the primary objective. Trees in intercropping systems are typically located where they are less likely to negatively affect crops, such as in border plantings or as trees randomly scattered throughout farm fields (Vergara 1985).

Trees in border plantings serve many purposes even though they are not usually the main component of most intercropping systems. One of the primary reasons for planting trees around crops is farm delineation (Vergara 1985). Trees are used as a natural boundary marker separating one farmer's field from another. This can be particularly useful in dispelling land tenure disputes in places like The Gambia where there are no written titles to land. Tree border plantings and scattered trees in parkland environments provide many of the same products and services such as nitrogen fixation, mulch contribution, shade, erosion control, fruit or nut production, fuelwood, medicine, animal fodder, and timber (Nair 1993; Overstory 2007).

Government/NGO workers perceived villagers to be beginning to see value in planting certain trees, especially fruit trees. Interview participants detailed various tree and crop arrangements being practiced within the Western Division. Intercropping with fruit trees was seen as an up and coming system. Several of the respondents described the desires of women to plant fruit trees, particularly cashews and mangoes in and around their gardens in order to increase garden profits from the sale of nuts and fruit. Some participants explained how increasing numbers of male farmers were becoming interested in planting cashews within their groundnut fields because the trees could provide an additional source of income, especially since farmers could no longer rely on the sale of groundnuts to provide for a decent income.

However, several of the participants stated that traditional land tenure systems often inhibited people from planting or maintaining trees. They described how land tenure issues are a hindrance to the enhancement of intercropping with trees. Many stated that people who did not have primary rights to their land had difficulty in planting trees because they were only leasing the land for a designated period of time. Respondents also mentioned that women were often prevented from planting trees within their farms or rice fields because the land belonged to their husbands or other male relatives.

Homegardens were believed to be a somewhat prevalent agroforestry system in the Western Division. Seven out of twenty-one of the government/NGO participants identified homegardens as being important although only two thought homegardens were among the top systems working successfully in the Western Division. Homegardens are an ancient practice present in almost all tropical and subtropical climatic regions

predominately managed by women. They have been documented as part of subsistence farming systems in numerous parts of Asia, Latin America and Africa, as well as in tropical island regions such as the Pacific Islands and the Caribbean (Mitchell & Hanstad 2004). A homegarden is an assemblage of various plants which may include all or just a few of the following components; trees, shrubs, vines, herbaceous vegetation, and in some instances animals (Nair 1993). A homegarden is usually grown inside or adjacent to a home compound and is primarily maintained by members of the household, in particular women and children (Ali 2005).

Homegardens in The Gambia were reported by government/NGO participants to be less complex than in some other regions of the world. Many countries in the humid tropics have homegardens with multiple canopy layers and high plant species diversity. These homegardens consist of large numbers of crops and plant species. Typically one section of the garden space contains perennial trees that are harvested once or twice a year, while other sections are occupied by vegetables and other crops which are cultivated more than once a year (Ali 2005; Nair 1993).

Most interviewees attested to the presence of small homegardens or backyard plots in the Western Division, but nothing on the scale of large, multistoried homegardens containing numerous crops and trees seen in other areas of the world. Participants described homegardens to be small plots of land close to the home compound where a few vegetables such as onions, tomatoes, okra, and cassava were grown. Small numbers of popular fruit tree species such as mangoes, oranges, papaya and grapefruit were also present in homegardens.

Some government/NGO participants felt homegardens could not develop much beyond their current productivity levels because produce was mainly grown on small plots for subsistence purposes. In fact, the primary goal of a homegarden is to enhance an individual family's diet beyond whatever staple crops make-up the bulk of food consumption in the given rural area (Mitchell & Hanstad 2004). With even a modest effort, homegardens can supplement diets by adding increased nutritional value with vegetable, fruit, and animal products that would otherwise be absent from the diet.

Besides the primary goal of food supplementation homegardens have been observed to provide an additional source of income through the sale of excess food stores (Mitchell & Hanstad 2004). Many products obtained from homegardens are often sold at local markets or bartered for other goods at the village level. However, generally speaking interview participants felt Western Division residents were not thinking about the marketability of their homegarden products beyond small scale village markets.

Other constraints mentioned in regards to homegardens in The Gambia were seasonal rainfall patterns and traditional farm labor schemes which made homegardening difficult. Government/NGO participants thought people were too busy with farming tasks during the rainy season to give homegardens the care and attention they needed. Some also felt the upkeep of homegardens in the arid dry season involved too much increased labor requirements because many of the most popular vegetables, such as tomatoes, eggplant, and onions had to be watered by hand daily.

An overwhelming majority of the government/NGO group, 20 out of 21 participants did not view alleycropping as a prevalent agroforestry system that was working well in the Western Division. Alleycropping is best described as the practice of

planting agricultural crops between rows of nitrogen-fixing trees (Rocheleau et al. 1988). In alleycropping systems, nitrogen fixing tree species are planted in tightly spaced rows while crops are planted in-between the tree rows. It is hoped that the retention of trees alongside crops will improve soil quality by recycling nutrients, suppressing weeds, and controlling erosion on sloping lands (Okogun et al. 2000). These benefits occur through natural tree processes as well as the trimming and reapplication of tree branches or leaves into the soil. In some instances the addition of fodder for small ruminants from alleycropped trees is also a desired benefit (Danso & Morgan 1993).

A majority of participants were aware of the alleycropping system but had not seen it being practiced much in the country. Several others mentioned alleycropping experiments or trials they had participated in where the results had provided little or no improvement in crop productivity. There was only one respondent that thought alleycropping was prevalent, and they were also the only one to believe alleycropping was working the best out of the eight systems in question. However, the respondent based this conclusion mainly on his promotion of alleycropping in the Central River Division over a decade ago.

Among the 20 interview participants who did not feel alleycropping was prevalent or successful, there were several explanations provided as to why. They explained that alleycropping required more work of farmers, which caused them to be disinterested in the practice. In addition, participants felt alleycropping was not feasible in The Gambia because of climatic constraints, specifically water limitations. These suggestions of increased labor requirements and climatic constraints fit in closely with the general

scientific findings related to alleycropping worldwide (Danso & Morgan 1993; Nair 1993).

In addition to the specific limitations discussed for each of the eight individual agroforestry practices and their influence in the Western Division, the government/NGO participants were also asked to generally speak on the main constraints they saw to agroforestry implementation in The Gambia (Table 4).

Government/NGO Responses- Major Constraints to Agroforestry in The Gambia		
Financial	**Social**	**Environmental**
Lack of materials (e.g. seeds)- 8	Lack of Awareness & Extension- 14	Rainfall- 5
Lack of money for program implementation- 7	Traditional values, beliefs, practices- 8	Bushfires- 5
Markets- 2	Land Tenure-7	Soils- 2
Corruption- 1	Lack of Technical Training- 5	
	Government Intervention-people have no choice- 1	
	Too much work- 2	
	Donor Dependency- 2 Outside values forced on locals- 1	
	Taboos-2	
	Population pressure- 1	
	Need more government assistance- 1	
	Lack of motivation- 1	

Table 4: Summarization of major government/NGO group responses

Compilation of the government/NGO responses revealed that barriers classified as social constraints, such as lack of awareness and extension were believed to be the biggest limitations to agroforestry implementation in The Gambia. Interview participants mentioned a general lack of awareness about agroforestry on the part of local communities as well as the environmental extension agents in charge of disseminating

agroforestry science. Agroforestry has been present in the country for quite some time with various project trials and research studies dating back to at least the early nineties. One of the interview participants confirmed this in his mention of alleycropping trials occurring over a decade ago. In addition, NARI the national agricultural research center has had an agroforestry unit specially tasked with conducting research since 1993. Other projects like the large scale woodlot project of the 1980's and the testing of fodder bank reserves around the same time are good examples of past agroforestry experience within the country (Schroeder 1999). Moreover, all of the government/NGO participants stated their organizations were involved in agroforestry in some form or another.

Yet interview participants felt there was still a gap between agroforestry research and agroforestry dissemination occurring within the country. Most of the participants thought agroforestry technology was not reaching the greater majority of the Gambian people. A good number mentioned how agroforestry was not promoted on a large scale as of yet, however they thought agroforestry implementation would become more common place if promotional techniques were stepped up. Lack of awareness and extension was linked back to one main cause mentioned most often in the government/NGO interviews which was a lack of cooperation between governmental departments.

At present, there does appear to be a lack of cooperation between the Department of Agriculture and the Department of Forestry which are the two main governmental agencies involved in environmental extension work within the country. Neither organization feels agroforestry falls under its project goals or objectives. This is not a problem unique to The Gambia, as there has been a traditional divide between agriculture

and forestry in governmental business operations throughout most of the world (Izac & Sanchez 2001; Puri & Nair 2004; Sinclair 1999). The government has stated in several documents that agroforestry should become a top priority, as it is a system that can address many of the countries resource issues. For example, a document from the second National Program to Combat Desertification forum held in 2000 states, "There is an urgent need to identify large-scale interventions in the priority areas of conservation farming, agroforestry, and range management. All parties are called upon to address this task as soon as possible" (Sillah 2000). The forum emphasized the government's responsibility to raise awareness, disseminate information, and education the public through environmental education measures. However to this date, little has been done in terms of extension to increase awareness about the potential of agroforestry to help alleviate poverty and reduce environmental degradation.

Under the financial and environmental categories the government/NGO interview respondents also mentioned several top constraints which may be limiting agroforestry within the country. Many talked of their organizations lack of funding for basic agroforestry implementation needs like seeds and tree nursing materials. Some also discussed a lack of funding for project implementation. Many organizations mentioned they were interested in other agroforestry projects but because of inadequate funds they were unable to begin new projects. Some interview participants recognized low amounts of rainfall and yearly bushfires to be somewhat of a restraint to proper agroforestry implementation, but the majority of respondents did not consider environment limitations to be a huge barrier to agroforestry implementation in The Gambia.

Kafuta Villager Survey Results

Results from the village survey carried out in Kafuta were somewhat different from the finding of the government/NGO group. There appeared to be a disconnect between what agroforestry practices the government/NGO participants were promoting and claimed to be working in the Western Division and what was actually being implemented in Kafuta.

Survey results from Kafuta demonstrated little knowledge or use of shrub-livefencing on the part of Kafuta residents. However the village surveys revealed a strong need to protect farms, gardens, and rice fields from both domestic and wild animals who were very disruptive to crop productivity. When asked about problems experienced in their farmlands many people said animal pests were the biggest constraint to crop yield. In fact, 70% of the survey participants routinely had difficulties with animals destroying their crops. Bush pigs, monkeys, parrots, and small birds were all blamed for crop losses in the rice and farming fields. While domestic animals such as goats, sheep, cows, and pigs were most commonly disruptive to farms and gardens. However, when asked whether farming plots were protected with some type of fencing, 15 out of the 16 men interviewed said no. Only one man claimed to have placed a barbed wire fence around his cashew plantation. Yet it is important to note that fencing may not prevent some animals, particularly wild animals such as monkeys, parrots, and small birds from disturbing crops. In these instances the traditional practice of having children scare away wild animals with noise and sling shots during the daytime may be more effective.

Similarly, all 18 women interviewed reported having no fencing around their rice fields. This is most likely due to the fact that farming plots and rice fields are located on communal lands. A person may not be allocated the same plot of land every year so he or she may have little incentive to build a fence. Even if a person was motivated to fence their farm or rice field they may not be allowed to do so on communal property. In addition, since field plots are usually quite large (3-4 ha), fencing them may be unfeasible for resource poor farmers. The one man with a fence around his farmland appeared to be better off financially than the rest of the farmers surveyed because as a teacher, he had an additional source of income. A possible solution to unprotected communal property would be the establishment of a community fence, which would enclose all communal property with the financial, as well as time and labor costs being divided between all community members.

Although almost all farms and rice fields were unfenced, a high percentage of the individual gardens owned by the women were fenced. Nearly 80% of the women interviewed said they had fences around their gardens. The fences were locally made from palm branches and various forest tree species and were for the most part effective in keeping out animal pests. However, many of the women mentioned that these traditional fences were prone to deterioration after only a few years because the local construction materials were not sturdy. Strong winds, torrential rains, termites, and cows were the main culprits of continual fence destruction. Research suggests that maintenance and reconstruction of a traditional local fence can take up to fifteen days a year (Laakso & Tyynela 2006). Some women stated they did not have enough time to mend their fences and therefore pests were getting into their gardens on a routine basis.

Lack of adequate fencing is apparently a major issue for subsistence farms in Kafuta yet none of the respondents mentioned the use or knowledge of shrubby livefencing anywhere within their community. Promotion of shrub-like livefencing has either not reached Kafuta or has not been accepted by the people, possibly due to barriers mentioned by the government/NGO group, i.e., increased labor, a time-lag element, and lack of adequate skills for proper implementation and maintenance or due to other barriers not mentioned by the government/NGO group, such as land tenure and suitability for the region.

However, some village survey responses as well as personal observations revealed that in some cases cashew trees were being planted to create fence posts for future livefencing purposes in Kafuta farms. One of the village participants had been growing cashews for a number of years and had the financial resources to close in his livefence with wire. Although, the wire will eventually deteriorate over time the cashews will remain strong, thus providing him with both fruit and nuts from the trees, as well as secure land tenure through boundary delineation from his neighbor's farms. Other farmers without the financial resources to buy wire were observed planting cashews using a close spacing which formed a more open fence. These fences were not effective in keeping out stray animals but they were working well for farm demarcation and income enhancement.

Villager responses suggested that relatively abundant wood in the area was the reason for little use of woodlots in Kafuta. However, villagers were not specifically asked about fuelwood collection in the village survey. According to village surveys done by NARI in 2005 local communities throughout The Gambia did not perceive fuelwood to

be in short supply. Most Kafuta residents appeared to have the same perception because they could easily collect wood from nearby forests which were abundant in wood resource in comparison to other regions of the country. If forest reserves continue to diminish in the Western Division, as they have in other regions of the country woodlots may become a more essential component in Western Division communities like Kafuta. But presently Kafuta does not seem to be concerned with the current amount of fuelwood consumption coming out of the forests.

Similar to woodlots, Kafuta villagers did not appear to be using firebreaks within their community. They did not have a community forest firebreak and personal conversations with farmers did not indicate the utilization of firebreaks on an individual basis within the farming landscape. However some neighboring villages did seem to be receiving numerous benefits from community forest firebreaks. For example, in Berefet (a village just up the road from Kafuta), community members were observed to be very active in managing their community forest firebreak. Villagers were seen cutting down trees that were beginning to be overcrowded. The lumber gained from the thinning was sold locally and the proceeds from the sale contributed to the community fund. In addition, the lower limbs of the gmelina trees were pruned back and used as fuelwood for community members who participated in the pruning.

Windbreaks were similarly seldom seen in Kafuta. However the survey did not directly ask participants about windbreaks so some of the respondents may have in fact been practicing the system without the interviewer's knowledge, although cashew livefencing used as border plantings were observed along numerous farm boundaries in Kafuta and may have been serving the additional purpose of reducing wind penetration.

It is likely that farmers were aware of these trees wind breaking potential, although the cashews were probably planted more for farm boundary delineation and income enhancement through the sale of cashew nuts than for a windbreak.

Correspondences with interview participants suggest the system may have development potential in the North Bank Division but not as much in the Western Division. Village interview participants in Kafuta did not seem to perceive wind as a major threat to their farms or home compounds. For this reason, adoption of the system may be slow in coming in regions of the country that are little affected by wind.

Villagers in Kafuta tended to view fodder banks as unnecessary. Ninety-nine percent of survey participants in Kafuta owned animals. The majority of households owned chickens while a great deal owned one or two goats and/or sheep. A couple of families also owned donkeys and cows which were used for plowing farm fields. However, when asked what they feed their animals most villagers said their animals ate freely from the bush and surrounding farm fields. Some farmers did admit to cutting a few branches from forest trees during the last few months of the dry season to help sustain their animals until the start of the rainy season. But for the most part, local people did not see a present need for fodder banks in Kafuta because they were able to sustain their animals under the current free grazing system.

Half of the male farmers interviewed in Kafuta said they employed traditional, agricultural intercropping techniques. However, intensive intercropping with trees typical of some West African agroforestry parkland systems was not a system readily employed by Kafuta farmers. Research has noted that many farmers believe plants grow poorly under trees because crops are competing with trees for sunlight, nutrients, and

water (Belsky 1993; Puri & Nair 2004). For subsistence farmers in The Gambia who greatly depend on the production of agricultural crops for survival, trees are most likely not a priority.

Yet, 70% of the farmers interviewed said they maintained at least a few scattered trees on their cropland. The trees most commonly retained on farms were ones which provided some type of noticeable benefit. For instance, a great deal of the women farmers told of sustaining palm trees in their rice fields because they were useful both socially and environmentally. Many used the branches to fence their gardens and others claimed the retention of palms (*Elaeis guineensis*) and sometimes different varieties of fig trees (*Ficus iteiphylla)* and (*Ficus exasperta*) helped to maintain high water levels in their rice fields which were important to rice cultivation. A couple of the women also mentioned that leaves from trees left in the fields helped to fertilize the soil. It was a common practice for them to harvest some of the leaves for home consumption and leave the rest for soil enrichment purposes. The men also maintained a variety of native trees to provide for multiple benefits like shade (mahogany-*Khaya senegalensis*), animal fodder (gum arabic-*Acacia nilotica*), fuelwood (African locust bean-*Parkia biglobosa*; ironwood *(Prosopis africana*), and food (cola nut-*Cola acuminata*). They too talked about the soil improving qualities of certain trees (winter thorn-*Faidherbia albida*) left in their farm fields.

Results from the village surveys revealed similar findings to the government/NGO group as to the lack of extensive, multistoried homegardens in Kafuta. However 90% of the women interviewed said they maintained some type of homegarden in their backyards. The women grew a variety of crops similar to crops grown in

community gardens. The most common vegetables were peppers, okra, bitter tomatoes, cabbage, eggplant, squash, onions, and tomatoes. However, most women's gardens were dominated by only three or four of the above named vegetables. A few of the women also grew root crops like cassava or sweet potato and several mentioned the presence of one or two fruit trees such as mango, orange, and papaya.

Also, fourteen out of the sixteen women who owned homegardens said they sold at least some of the vegetables at the local market. The majority of women sold almost all of the vegetable they produced and kept only a small amount for home consumption. The women said the sale of their homegarden products provided their families with a small supplemental income, which was used to pay for school fees and to buy extra food when the groundnut and cous stores ran out. Since the average length of food stores after the final harvest is on average only four months, any additional money received from homegardens was quite beneficial. While homegardens in Kafuta were not observed to be the diverse, multistoried homegardens seen in other regions of the world, they did seem to be a vibrant part of the local people's livelihood strategy, contributing to both family diets and household incomes.

None of the survey participants in Kafuta shared any knowledge of alleycropping. Villagers did not seem to be aware of growing trees in rows for soil improvement qualities and none of the villagers claimed to have received training on alleycropping practices

In summary, household surveys showed that local people did have knowledge of agroforestry practices; however their use was somewhat limited. In addition, the practices being used were for the most part traditional practices with the occasional

modification. For instance, intercropping with trees had always been apart of Gambian culture in agroforestry parklands, yet some farmers had started to introduce more marketable species like cashew and lime into their fields. On the other hand, the planting of livefences was a relatively new agroforestry practice to farmers, although changes in the social structure had encouraged farmers to start to adopt the practice for property delineation as well as added income generation.

However, for the most part Kafuta farmers appeared to have a very limited knowledge and use of various agroforestry techniques. Farmers seemed to be the most comfortable with familiar crops and farming techniques. Ninety-four percent of Kafuta villagers said they were growing the same crops as they had been growing ten years ago, in much the same fashion. Only two male participants had started planting cashews in their farm fields within the last several years. Forty percent of the villagers acknowledged trying a few things differently from their neighbors; however the varying techniques were mainly related to increases in field mechanization, such as tractors and animal drawn plows. A couple participants also mentioned the use of fertilizer although they claimed they were unable to continue the practice because of the high cost of commercial fertilizer.

When Kafuta farmers were questioned about the main problems experienced in their farms many of them mentioned problems that were not being addressed by the agroforestry systems being promoted and/or implemented in the Western Division by the government/NGO participant organizations, in particular insect damage of crops, lack of adequate machinery, and water constraints during the long dry season (Table 5).

Major Farming Constraints	Number of Participant Responses
Animal pests	24
Insect damage	12
Lack of fertilizer	10
Lack of machinery	9
Lack of water	8
Poor soils	7
Poor fencing	4
Land tenure	3
Lack of seeds	1

Table 5: Major constraints to farming in the village of Kafuta

Although, agroforestry could possibly address insect damage on crops, particularly in homegardens through the presence of many diverse plant materials. Research suggests that complex agroforestry systems favor the establishment of natural enemies of insect pests (Rathore 1995). For instance, odors released by different plant species can interfere with insects' orientation skills, thus inhibiting their ability to effectively attack crops. In addition, trees raised with crops in agroforestry fields can act as physical barriers to insect movement (Rathore 1995).

The village surveys also revealed a high incidence of poverty among Kafuta families. These finding were in disagreement with poverty data collected in 1996 by the Central Statistics Department, which ranked Western Division residents with the smallest incidence of poverty (Figure 7). This study defined the 'very poor' as people who were unable to acquire enough food for subsistence purposes, the 'poor' were those who could meet subsistence food needs but could not meet other basic needs, and the 'non-poor' were those who could adequately satisfy both food and other basic needs (Brown et. al 2002).

Incidence of poor households by administrative division (%)

Division	Very poor	Poor	Non-poor
North Bank	36	24	40
Upper River	14	36	50
West	6	11	84
Lower River	35	26	39
Central River (north)	45	22	33
Central river (south)	24	27	49

Figure 7: Incidence of poverty by administrative district, 1996 data (Brown et al. 2002)

The village surveys done in Kafuta showed that many of the interviewed households could meet basic food needs, although the majority of families were unable to produce enough food during the harvest season to last the entire year. In fact, food stores on average lasted only four months for the majority of households interviewed (Table 6). The rest of the year, households would either have to buy food with the money they earned from groundnuts sales or other secondary sources of income.[1] Many would have to borrow food from family and friends. Borrowing could be a huge burden considering the average compound size of households interviewed was sixteen people. Furthermore, money received from groundnut sales was often times inadequate to buy extra food reserves. Seventy-eight percent of the families surveyed received their main source of income from groundnut farming. Therefore, most had only a small amount of income during the rest of the year to buy food and other basic needs requirements, unless they were engaged in other off-farm activities, like carpentry or vegetable gardening.

Furthermore, most families owned only a few smaller animals, mainly of smaller size. The possession of animals, especially large animals is a sign of wealth in many African countries because they are used as a type of savings account (Madge 1995).

[1] At the end of the 2006 groundnut harvest many farmers still had not received payment for groundnuts handed over to buyers. A similar situation occurred in the 2004-2005 harvest season (Brouwer 2006).

Most families interviewed owned at least a handful of chickens while several others possessed one or two larger animals such as goats and sheep. However, only a very small percentage of farmers were wealthy enough to own draft animals such as cows and donkeys (Table 6).

Kabilo	Total # in household	Main Source of Income	Possession of Animals (C=chickens, S= sheep, G= goats, D=donkey,CC= cow,P=pig)	Possession of Farming land (F=farm, G=garden, R=rice field, P= tree plantation)	Size of Farm	B=Borrow or Rent, O=Own	Same things grown ten years ago	Training or workshops
Basanto 1	8	Farming	Male- S	Male-F Female-G	Male-2 ha Female-1 ha	Female-B	Yes	No
Basanto 2	26	Teaching	Male- 1 S Female -G,S	Male-P Female-G,R	Male-5ha Female-G 1ha, R 3ha	Male-O Female-O	Male-cashew now	Action Aid-orchards/gardening
Temasue 1	14	Farming	Male-C Female-C	Male-F Female-G,R	Male-3 ha Female-2 ha	Male-O Female-B	Yes	No
Temasue 2	6	Farming	Male-C Female-C	Male-F Female-G, 2R	Male-3 ha Female-3 ha	Male-B Female-R(B),G(O)	Yes	No
Fula Kunda 1	28	Farming	Male- 1 D	Male-F Female-F	Male-2ha Female-2ha	Male-O Female-O	Yes	No
Fula Kunda 2	10	Farming	Male-C Female- 2 G	Male-F Female-F,G	Male-1 ha Female-3ha	Male O Female-B	Yes	Female; DOA-fertilizer
Waneka Kunda 1	13	Farming	Male-S Female-C	Male-F Female-F	Male-1 ha Female-1 ha	Male-B Female-O	Yes	No
Waneka Kunda 2	21	Farming	Male C Female-C	Male-F Female-F	Male-4ha Female-2ha	Male-B Female-B	Yes	No
Baduma 1	25	Farming	Male-2 CC, 1 G Female-C	Male-F Female-G,R	Male-2ha Female-G 1ha, R 3ha	Male-O Female-O	Yes	Male-fertilizer trials
Baduma 2	21	Farming	Female-2 G, 1 S, C	Female-F,G	Female-F 2ha, G 1ha	Female-B	Yes	Female-rice field, seeds
Taba Kota 1	7	Fishing	Male-C Female-C	Female-G	Female-1 ha	Female-B	Yes	No
Taba Kota 2	19	Farming	Male- S Female-C	Male-F Female-F,G	Male-3 ha Female-G 2ha, R 3ha	Male-B Female-B	Yes	No
Naama Kunda 1	12	Farming	Male-C	Male-F,P Female-G,R	Male- F 3ha, P 5ha Female-2ha	Male-B Female R(B), G(O)	Male-cashew now	Male-fertilizer trials
Naama Kunda 2	15	Farming	Male-G,S Female-C	Male-F Female-F,G,R	Male-3ha Female-F 2ha, G 1ha, R 3ha	Male-B Female-R(O),G(B)	Yes	No
Mbula 1	18	Farming	Male-G Female-C	Male-F Female-G,R	Male-2 ha Female-2 ha	Male-B Female-R(B),G(O)	Yes	Female; SJFF-gardening
Mbula 2	22	Teaching	Male-G,P,D Female-C	Male-F Female-F,G,R	Male-2 ha Female-F 2ha, G 1ha, R 2ha	Male-B Female R(B), G(O)	Yes	No
German 1	5	Farming	Female-C	Male-F Female-F	Male-4ha Female-3ha	Male-B Female-B	Yes	No
German 2	13	Driver	Male-G,S,D, C	Male-F Female-F,G,R	Male- 2ha Female-F 2ha, G 1ha, R,1ha	Male-B Female-B	Yes	Female; gardening & shifting cult.

Table 6: A portion of village survey results from Kafuta

DISCUSSION

The government and NGO workers stated that lack of awareness and extension activities, along with some lack of financial support and a few environmental problems, were the primary constraints to increased implementation of agroforestry practices in the Western Division of The Gambia. In contrast, interviews with farm households and participant observations in the village of Kafuta suggest that household needs and interests, land tenure issues, and the promotion of inappropriate species and practices explain the low use and adoption rate of agroforestry practices.[2]

A lack of agroforestry awareness and extension as well as various financial and environmental constraints mentioned by the government/NGO group are most likely valid in regards to the application of agroforestry systems in the Western Division of The Gambia. However, the general lack of agroforestry development in the village of Kafuta may possibly be due to the inappropriate promotion of various agroforestry practices due to more critical and underlying factors such as land tenure and perceived needs.

Scientific literature suggests a key limitation to agroforestry implementation is the promotion of practices which are not well suited or entirely inappropriate for a specific region (Izac & Sanchez 2001; Pattanayak & Mercer 1996; Russell & Franzel 2004; Scherr 1992; Thangata & Alavalapati 2003). Frequently there has been a mismatch between promoted agroforestry practices and farmer incentives to implement them because local primary realities, needs, and constraints have been largely ignored (Scherr 1992; Vandenbeldt 1990).

[2] It is important to note that because The Gambia is quite diverse; containing 14 different ethnic groups, the finding from the Western Division and village of Kafuta may be difficult to extrapolate to other regions of the country.

Furthermore, various research studies recommend implementing agroforestry practices that match the needs and desires of the local populace (Izac & Sanchez 2001; Pattanayak & Mercer 1996; Russell & Franzel 2004; Scherr 1992; Thangata & Alavalapati 2003). Different people value resource differently therefore not everyone will find a particular technology beneficial to their specific needs. In many instances the old way of doing things works best for rural farmers because traditional practices are well-known, easily implemented, and generally mesh well with the local history and cultural.

Woodlots and fodder banks provide a good example of systems that do not currently fit villager needs. Kafuta still has access to abundant forest and grazing reserves so many of the researched practices may not be quickly taken up for the time being while resource reserves remain relatively high. Since the Western division is still relatively well forested Kafuta villagers did not appear to perceive fuelwood or fodder to be in short supply. Villagers can still easily fetch wood from the forest and their animals are able to adequately graze off of forest grasses. Therefore these two agroforestry systems are inappropriate for Kafuta because they are not presently needed.

Furthermore, the research process made evident the inappropriateness of most of the eight agroforestry practices for the village of Kafuta because of land tenure constraints. Numerous publications suggest insecure land tenure is a major limitation to successful agroforestry implementation (Coomes & Burt 1997; Degrande 2001; Leakey 1998; Montambault & Alavalapati 2005; Scherr & Franzel 2002; Suyanto et. al 2005; Tarawali et. al 1999; Teklehaimanot 2004). Research has shown that farmers who do not

have secure land tenure are often not interested or unable to invest in long-term measures such as tree planting (Rasul and Thapa 2006; Quansah et. al 2001; Viswanath et.al 2000).

Even though The Gambia is a small country, tenure practices are diverse and vary immensely depending on the specific village and region in question. In Kafuta, the reality of the current land tenure status reveals a huge constraint to agroforestry implementation. Individuals in The Gambia usually only have usufruct rights to land because of communal land vestments (Freudenberger 2000). Most often the village chief or village elders are in charge of all communal land because they are direct descendants of founding families (Brown et. al 2002; Freudenberger 2000). In more recent times, legislation has been passed to allow for 'area councils' to be democratically elected from the local populace. These elected councils technically have the power to legislate bylaws applicable to entire districts or territories. However, the majority of area councils lack legitimacy and the respect of the local people because they are most often perceived as ineffectual and non-responsive to local needs. In fact, still to this day local village chiefs and elders play a more significant role in local-level resource management.

Councils of elders, chiefs, and respected heads of extended families hold land in trust for qualified community members. They negotiate among themselves every year for the allocation of land to members of the community, in particular new or marginalized members who are looking for a plot of land to cultivate for subsistence purposes. Land use controls such as prevention of soil erosion; control of pests such as tsetse flies, mosquitoes, and weeds; improvement of soil productivity and preservation of soil fertility; management of stray animals; and control of rainy and dry season grazing

pastures are just a few of the ways village elders in respected family lineages regulate land use (Freudenberger 2000).

Traditionally all land within a few miles of a village center, including farmland and uncleared, uninhabited forest has been communally owned (Brown et al. 2002). Thus, the collection of forest products and free grazing of domestic animals is permitted for all user groups under communal land tenure agreements. What appears to be unclaimed land between villages is most likely possessed by nearby villages through complex, historical land acquisition agreements.

Customary land tenure systems in The Gambia still remain strong and are supported by the state legal system. Traditionally agricultural lands have been loaned between family lineages to foster adequate bush fallow rotations or to aid in the protection of crops against the raiding of wild animals (Freudenberger 2000). However, with increased land scarcity and concern for environmental integrity, governmental policies have begun to prohibit the creation of new villages or the expansion of agricultural fields into uninhibited woodlots most often found between village centers (Freudenberger 2000). In most instances, villagers who do not have access to inexpensive fertilizer essential to maintaining soil fertility are forced to remain on land which has become unproductive due to inadequate regenerative fallow periods.

In The Gambia, primary rights to land are still most commonly transferred through inheritance customs, although the sale of land has recently evolved as a way to secure primary rights in areas with increasing land scarcity. In the past, low population densities combined with sustainable indigenous farming practices had prevented a great deal of land distribution problems in Africa (Norman et. al 1981; Toulmin et al. 2002).

Yet with increasing populations and involvement in global markets, traditional land tenure systems have become less stable (Otsuka & Place 2001). Farmland ownership in The Gambia has gradually shifted to a more individual status, where a large majority of land transfers now grant 'freehold' ownership rights (Brown et al. 2002). This type of land transfer has become more frequent in villages near the capital, like Kafuta, indicating a rapidly developing land market near the coast (Brown et. al 2002; Freudenberger 2000).

Furthermore, as land has become more scarce and thus more valuable, families owning firm rights to land have increasingly been encouraged to transfer rights to secondary holders through leasing practices such as borrowing, pledging, renting and sharecropping (Brown et. al 2002; Freudenberger 2000). These types of arrangements have been shown to discourage the conservation or improvement of rented lands since alterations made to land are sometimes seen as an imposition of rights suggesting a renters wish to hold on to control of the land. There have been many instances were landowners revoked rental agreements because of such fears (Freudenberger 2000; Norman et. al 1981; Quisumbing et. al 2001; Schroeder 1999; Suyanto et. al 2001; Toulmin et. al 2002).

Different forms of rental arrangements can be beneficial to all parties involved. Landowners can gain gifts, a share of produced crops, or even direct payment for rented land. While landless renters receive a place to grow food for subsistence needs. However in The Gambia secondary rights holders are unofficially forbidden to plant trees because tree planting is considered a privileged act of primary rights holders (Brown et. al 2002). Specific tree tenure in The Gambia suggests the planting of a tree confers

ownership; therefore tree planting is often viewed as an unwelcome improvement or alteration to rented lands. In other words, primary landholders perceive tree planting on rented lands to be a threat to ownership rights.

Every agroforestry system under review in this study involved the planting of trees or shrubs in some form or another and since a great majority of farmers in Kafuta are not primary land holders it is reasonable to suggest the lack of agroforestry implementation in the village could primarily be due to current land tenure arrangements. Moreover, the village of Kafuta is particularly vulnerable to recent shifts in land tenure arrangements because of its close proximity to the urban areas. As more people have migrated to Kafuta land scarcity and population pressure have encouraged a great deal of land subletting within the village.

Out of the villagers interviewed in the village based surveys 72% of the women and 56% of the men did not own all or a portion of their farming lands. Some of the village survey participants also discussed how they were unable to plant trees on rented property because they were not the primary owners. Similarly, one participant mentioned that he would like to cut more of the trees on his farm in order to reduce shade but because he was not the owner he had no say in the management of the trees.

In addition, collective knowledge of land tenure systems suggests agroforestry practices may be most successful when ultimate rights and responsibilities are held either by an individual or by a single household (Gezon & Freed 2003; Schroeder 1999). For instance, agroforestry systems such as woodlots and firebreaks which received a great deal of praise from the government/NGO participants could be absent in the village of Kafuta because of issues arising from communal land tenure arrangements. The planting

of trees for woodlots and firebreaks may easily be accepted in community forest reserves because no one person has the right to the land or the trees. However, past evidence suggests communal agroforestry systems are hard to implement because communities are unable to distinguish individual user rights to benefits. Therefore, these two systems may not have been well received in Kafuta up to this point because villagers are not interested in investing additional time and labor into a project where they are not guaranteed an equal share of the benefits.

RECOMMENDATIONS FOR THE VILLAGE OF KAFUTA

As livefencing, intercropping with trees, and homegardens were already functioning in Kafuta, the most feasible recommendation would be to enhance and improve upon these practices as a means of increasing livelihood security. Because they were already being practiced to an extent, and were well adapted to the unique biological, physical, and socioeconomic characteristics of Kafuta, simple modifications to increase productivity would most likely be easily adopted by Kafuta villagers.

Homegardens are a traditional practice that has been occurring for centuries in Kafuta. Sixteen out of the eighteen Kafuta women interviewed in the village surveys said they maintained some type of a homegarden. A majority of the women sold most of their homegarden produce in order to earn a supplemental income for their families. Most homegardens in Kafuta were placed within close proximity to the home making them easily cared for by the women and children, plus many Kafuta homegardens were already fenced and had a good source of nearby water.

Homegardens are perhaps the only agroforestry system not impeded by land tenure issues in Kafuta because they are typically owned directly by the residing family. Improvements made to homegardens through tree planting activities would most likely not be limited by tree and land tenure constraints as with other agroforestry practices because of secure land ownership. Other research studies have verified the high success of homegardens because ultimate rights and responsibilities are held either by an individual or a household (Gezon & Freed 1999; Russell & Franzel 2004).

The enhancement of homegardens would simply involve the planting of more vegetables, cereal crops and in particular fruit trees such as mango, lime, cashew,

avocado, passion fruit, and papaya, which produce highly marketable fruits that can be sold in the urban markets. Homegardens could also be enhanced through the incorporation of green manure cover cropping, which involves the growing of nitrogen fixing species to be incorporated back into the soil, as a means of maintaining soil fertility. Cowpea (*Vigna unguiculata*) is a good example of a crop that could be planted in sections of a homegarden which may be experiencing decreased productivity due to overuse. In addition, households that own animals could improve upon homegarden production with better management of animal dung. Collection of manure from stalls where animals are kept overnight could readily be applied to homegarden plants as an organic fertilizer. Furthermore, the intentional planting of tree species within the homegarden to be used as cut-and-carry fodder for animals such as goats, sheep, and cows could improve the overall productivity of Kafuta homegardens.

Even though homegarden diversity is somewhat limited within the Gambia because of the semi-arid climate, the Western Division receives considerably more rainfall and experiences milder year round temperatures because of its prime location near the coast. Temperature in the Western Division during the height of the rainy season range from 100 to 110° F, yet rarely climb over 85 to 90° F in the dry season. This is a significant difference when contrasted with villages in the Central and Upper River Divisions that regularly see temperatures of over 120° F in the wet season and around 100° F in the dry season. Furthermore, the amount of rainfall received by the Western Division is significantly more when compared to interior regions of the country. Annual precipitation near the coast is around 1,300 mm versus only 600 mm in the far east of the

country (Brown et al 2002). For these reasons the growing of more fruit tree species would not be as unachievable in Kafuta as in other regions of the country.

In addition, Kafuta is within close proximity to the urban markets making the selling of goods and services highly profitable for Kafuta residents. Studies have shown that communities closer to market areas are more apt to invest in agroforestry practices because the benefits are quickly realized and costs are not as great (Montambault & Alavalapati 2005). For instance, transportation to the urban centers is relatively cheap for Kafuta villagers because of the short distance. In addition, the main south bank road is paved and in good condition nearly the entire way from the capitol to Kafuta. Traveling to this region is cheap, quick and for the most part comfortable, unlike transportation to other parts of the country where roads are unpaved and filled with pot holes.

Kafuta clearly has many advantages for homegarden production and product sales over other regions of the country, due to the areas mild climatic conditions and its close proximity to large, urban markets. Within the past decade increases in tourist activity on the coast have created a vibrant horticulture sub-sector, making the production of fruits and vegetables a key economic growth factor for the country (NARI 2004). Women in Kafuta could readily tap into this market if they were able to produce more fresh fruits and vegetables from their homegardens, with the hopes of increasing secondary incomes.

Intercropping with cashews and the planting of cashew trees in livefencing arrangements are newer agroforestry systems to Kafuta. Both appear to have developed as income generating activities through the sale of cashew nuts, although cashew livefencing has in recent times also developed as a means to increase land tenure security. The placement of cashews amongst crops and around farm boundaries does not greatly

differ from traditional agricultural parkland systems where competition between crops and trees is controlled by either placing the trees along farm edges or at wide spacing arrangements among crops.

The majority of farmers are still unaware of the huge benefits involved with cashew livefencing and intercropping with cashews. Profits from groundnut production have dropped dramatically in recent years and only a few farmers in Kafuta have had the foresight to plant cashews as a means of income supplementation. However, most Kafuta farmers are entirely dependent on groundnut sales and have been increasingly experiencing economic hardships. The implementation of intercropping with cashew and cashew livefencing on a larger scale has the potential to greatly enhance income generation for Kafuta farmers. In addition, cashew livefencing has the added benefit of farm boundary delineation. Land scarcity and population pressure in the village of Kafuta has created an increasing interest in the establishment of livefences primarily for land tenure security.

Both intercropping with cashew and cashew livefencing could easily be adopted on a wider scale among farmers in the village because these systems are highly profitable. Plus, land is becoming a precious commodity in the village and livefencing with cashew offers increased land tenure security. Again, access to the urban markets is quite simple for Kafuta residents. The sale and transport of cashews to the local urban markets, as well as international export markets is not a major obstacle to production. In addition, cashews have been noted to grow well in the Western Division as compared to other regions of the country because of favorable climatic conditions (personal communication with German Forester, GGFP). The only major limitation to

livefencing/intercropping with cashew development in Kafuta would be land tenure. As discussed earlier Kafuta farmers who are not primary landowners may not be able to implement these practices on a wide scale because of traditional limitations of tree planting on rented land.

Increased livefencing/intercropping with cashew and improved homegardens have the potential to help rural families in Kafuta improve their economic condition and general well-being through greater income generation. Since most families are unable to produce enough food to last the entire year, added income is needed. In recent years The Gambian government has become more aware of the many difficulties faced by the Gambian people. The government's "Rural Development Strategy" states that some of the main causes of rural poverty can be attributed to low agricultural and labor productivity, low and future degrading soil fertility, crop yields that fluctuate up to 40% depending on weather conditions, and a lack of alternative income generating activities (NARI 2004).

Although intensifying livefencing/intercropping with cashews and improving upon current homegardens may not address all of these issues which contribute to rural poverty, they can most certainly offer increased income generation for Kafuta households. The other systems presented in this study may not be as appropriate for Kafuta because of the numerous constraints to implementation mentioned in the research findings.

Moreover, the Western Division and the village of Kafuta are not faced with deteriorating resources on the same scale as other areas of the country. As of yet, people do not see a need for some of the other systems that improve soil fertility, increase wood

production or provide fodder for livestock. Therefore the most appropriate agroforestry systems for the village of Kafuta are livefencing/intercropping with cashews and improved homegardens because these systems most closely resemble traditional agricultural and/or agroforestry practices. In addition, these practices are easily implemented and they have the potential to provide increased economic gains, which appears to be the most fundamental need of Kafuta residents.

In the future, if population pressure and agricultural expansion for groundnut production continue to be major driving forces in The Gambia, Kafuta may also want to consider adopting agroforestry systems which address decreasing soil fertility and significant reductions in fallow periods. Improved fallows, an agroforestry practice shown to increase soil productivity, could be used in Kafuta to add to the lengthy list of benefits already received from intercropping with trees, such as shade, animal fodder, fuelwood, food, and water retention. This agroforestry practice involves the intentional planting of nitrogen fixing cover crops and/or tree and shrub species in fallowed fields to enhance the productivity of the field and possibly decrease the amount of time the field must remain uncultivated (Degrande 2001).

Improved fallow practices have aided many African countries faced with decreasing soil fertility and low crop productivity due to shortened fallow periods. For instance, a study conducted in Zambia in 1987 revealed that farmers practicing improved fallows doubled their incomes from maize production when compared to farmers who were continuously cropping their fields (Phiri et. al 2004). Another study conducted in Cameroon in 1996 revealed that farmers were receiving higher crop yields from improved fallow fields, which were easier to clear because the shrubs shaded out most

weeds. Women in particular were speaking highly of the practice because it required low labor demands and even if the women did not have secure land tenure, they were able to plant shrubs because the plants would not permanently remain on the site (Degrande 2001).

Since improved fallows would not be competing with crops during the growing season Kafuta farmers may be apt to try them in the near future. Farmers already appear to be aware of the multiple benefits gained from maintaining a few trees in their farms. They may be willing to undertake improved fallows in order to gain additional benefits from the temporary vegetation maintained in fallowed fields. Aside from the benefits previously addressed by Kafuta villagers, improved fallows have the potential to greatly improve soil fertility and crop yields, while at the same time providing for dry season livestock fodder and fuelwood supplies, which may soon become increasingly scarce in the Western Division, as in other regions of The Gambia (Cairns 2007; Tarawali et. al 1999).

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APPENDIX A

Questions asked to local NGO and government workers in the Gambia:

1. What kind of background do you have in the natural resource field?
    a. Probe: Forestry, Agriculture, Agroforestry, Soil & Water, etc…
    b. Probe: Degree, certificate, work related experience
    c. Probe: Approximately how many years in the natural resource field?

2. Which area of the country do you have the most experience working in?
    a. Probe: District, Division, North Bank, South Bank, etc…

3. What organization/group are you currently associated with?
    a. Probe: How many years have you worked there?

4. To what extent does your organization work with agroforestry?
    b. Probe: Is it a major/minor part of your organizations projects?
    c. Probe: What kinds of projects do you focus on?

5. Which agroforestry systems' does (has) your organization promote (d) in the Western Division?
    a. Livefencing
    b. Woodlots
    c. Firebreaks
    d. Fodder Banks
    e. Alley Cropping
    f. Intercropping with trees
    g. Windbreaks
    h. Multipurpose trees
    i. Homegardens
6. Which systems do you feel are the most prevalent?

7. From your experience, which systems do you feel have worked well?
    a. Probe: Why?

8. What are some limitations to agroforestry implementation in The Gambia?
    a. Probe: *Environmental*: rainfall, soil, pests, etc…

        Social: acceptance, land tenure, taboos, etc…
        Financial

9. What do you feel is the future of agroforestry in the Gambia?
    a. Probe: Are there certain systems that will dominate over the rest?
    b. Probe: Will organizations still promote agroforestry has a viable land management system 10, 20 years down the road?
    c. Probe: Who will be the main beneficiaries of agroforestry?

APPENDIX B

Questions asked to a random sample of men and women in Kafuta village.

1. **Family Structure**
    1. How many people are in your immediate family? (In and outside the compound)
        a. Male--------b. Female------ c. Boys--------- d. Girls--------
    2. What is your family's main source of income?
    3. What kinds of expenses do you have?
    4. Do you own animals?
        a. What type? E.g. cows, sheep, goats, chickens, etc…
        b. Why do you own this type of animal? E.g. meat consumption/form of savings
        c. What do you feed them?

2. **Land Size and Tenure**
    1. Do you have a farm/garden?
    2. How big is your farm/garden?
    3. How did you acquire this land?
    4. Is your farm/garden fenced?
        - If so, what type?

3. **Crop Production**
    1. What do you grow on your farm/garden?
    2. Do you grow any crops together on the same field with your main crop?
    3. Do you grow the same things now as you did 10 years ago?

4. **Food Security**
    1. Do you sell or eat the majority of your crops?
    2. Is the money/food you receive from your crops enough to last the entire year?
    3. What kinds of foods do you eat? (rice, meat, bush fruit, mangoes, etc…)
        a. Does this change in the dry versus wet season?

5. **Multipurpose Trees**
    1. Are their trees in your farm/garden?
        a. What species of trees?
        b. How many?
        c. What are they used for?
        d. Did you plant them or were they already there?
        e. If already there, why were they maintained on the land?

6. **Constraints**
    1. What are some of the main problems you experience in your farm/garden?
        a. Water constraints
        b. Pests: domestic or wild animals
        c. Soil erosion/quality

7. **Government/NGO Outreach**
    1. Have you ever attended any trainings or workshops offered by the government or NGO's on farming/gardening?
    2. Have you tried anything new or different on your land that your neighbor's haven't tried?